Operating and Maintenance Handbook

MARCONI INSTRUMENTS LIMITED, ENGLAND

20-MC/S SWEEP GENERATOR

TYPE TF 1099-/1

MARCONI
INSTRUMENTS

OM 1099 -/1
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OPERATING AND MAINTENANCE HANDBOOK

for

20-Mc/s SWEEP GENERATOR

TYPES TF 1099 and TF 1099/1

AMENDMENTS, if any, are included at the end of this handbook.

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SCHEDULE OF PARTS SUPPLIED

1. One 20-Mc/s Sweep Generator Type TF 1099 or TF 1099/1, as ordered, including Input Probe Type TM 5332 and Output Probe Type TM 5331, and complete with valves, etc., as under :-

Valves:	Four:	Type 6AK5 (EF95), Pentodes.
	Six:	Type 6BH6, Pentodes.
	One:	Type 5763 (QVO3-12), Tetrode.
	One:	Type 6BJ6, Pentode.
	One:	Type 6CD6G, Tetrode.
	One:	Type 6BE6 (EK90), Heptode.
	One:	Type 12AT7 (B309), Double Triode.
	One:	Type 12AU7 (ECC82), Double Triode.
	One:	Type 6C4 (L77), Triode.
	Five:	Type EB91 (D77), Double Diodes.
	One:	Type 5V4G, Full-Wave Rectifier.
	One:	Type OA2 (QS150/15), Voltage Stabilizer.
	One:	Type 5651 (QS83/3), Voltage Reference Tube.
Oscillator Cryatal:	One:	Type QO1670A, 5-Mc/s Oscillator Crystal.
Semi-conductors:	Three:	Type CG4-E (CV448), Germanium Diodes.
	One:	Type OA202 (1N462), Silicon Diode.
Lamp:	One:	6.3-volt, 0.15-amp, M.B.C. Pilot Lamp.
Fuses:	Five:	2-amp, glass cartridge.
	One:	250-mA, glass cartridge, anti-surge type.

2. (TF 1099 only) One Mains Lead (attached) Type TM 2560AU.

3. One Coaxial Connector Assembly, Type TM 4726/18.

4. One Coaxial free plug, Type 83; for use with trigger input socket.

5. One Operating and Maintenance Handbook No. OM 1099 -/1.

M.I. Ltd.

1. DESCRIPTION

1.1. GENERAL

The TF 1099 is a video-frequency sweep generator which, in conjunction with a suitable oscilloscope, enables response measurements to be made with a discrimination exceeding 0.01 dB. Designed primarily for the precise alignment of monochrome- or colour-television transmitter and studio equipment, the Generator is equally applicable to any video response measurement where the highest order of accuracy is required.

The Generator provides a swept output signal extending from below 100 kc/s up to a maximum of 20 Mc/s. This signal is the result of mixing the output of a 60-Mc/s fixed oscillator with that of an oscillator sweeping the range 60 to 80 Mc/s. The maximum frequency is continuously variable up to 20 Mc/s and the minimum is locked by a.f.c. action to a constant frequency of less than 100 kc/s.

The output impedance of the instrument is 75 ohms and the signal level is continuously variable between 0.3 and 3 volts peak-to-peak. A 250-volt time-base waveform is provided for direct connection to the X-plates of the oscilloscope, and can be locked either internally to the mains supply or externally to any 50- to 60-c/s source, e.g. the field sync pulses of a television system.

In addition to providing facilities for conventional response measurements, the Generator includes special circuits for precision differential measurement. For the differential method, the overall gain of the apparatus under test is reduced to unity by means of an external attenuator and the sweep signals at its input and output are sampled by means of detector probes; the probe output signals, which are of opposite polarity, are balanced in a differential mixer circuit. Any small deviation in response is amplified and applied to the c.r.o.; the resultant deflection of the trace can be measured with an accuracy that is independent of both the frequency response and the output stability of the Sweep Generator.

Electrically, the TF 1099/1 is identical to the TF 1099. It differs only in that, whereas the TF 1099 is supplied in a pressed steel case for normal bench use and is fitted with a 3-pin mains plug and lead, the TF 1099/1 has neither case nor mains lead and is intended for mounting in a standard 19-inch rack.

1.2. DESIGN DETAILS

It is suggested that the following sections be read in conjunction with the Block Schematic and Circuit Diagrams included at the end of this handbook.

1.2.1. Time Base Generator

The time-base generator consists of a free-running Miller-transitron sawtooth generator, V1, providing a maximum output of over 250 volts. This large output is due to the inclusion, in the anode load, of a large inductor, L1, tuned to resonance at 50 to 60 c/s by means of C2.

The TRIGGER switch, SA, allows the generator to be locked either internally to the mains supply or externally to 50- to 60-c/s negative pulses having an amplitude of at least 2 volts. The locking pulse is fed to the suppressor grid of V1 via the trigger-pulse amplifier, V24. The time base may be locked by means of the TIME BASE HOLD control, which varies the potential to which the grid is returned.

The output to the X-plates of the oscilloscope is variable by means of the TIME BASE AMPLITUDE control, and is brought out to a screw terminal on the front panel of the instrument.

1.2.2. Time Base Amplifier and A.F.C.

A portion of the time-base output voltage is amplified and inverted by V11a for application to the grid of the modulator valve, V2. Negative feedback is applied between anode and grid of V11a to ensure good linearity. This valve also acts as a d.c. amplifier for the a.f.c. voltage which locks the low-frequency limit of the sweep to a stable fixed frequency of approximately 60 kc/s. The a.f.c. system operates in the following manner:

A series-tuned circuit, L2-C9, resonant at approximately 60 kc/s, is connected across the output of the Sweep Generator. (L2 and C9 are located to the right of V11a on the circuit diagram.) In the equilibrium condition of the a.f.c. circuit, the output sweeps through this frequency during the initial build-up of the output voltage. Each time this happens a resonant rise of voltage occurs across C9; this voltage is rectified by MR4 and applied as a negative charging pulse to C7. Between each

1.2.2. (continued)

successive impulse, C7 discharges slowly through R12 and R16, with the result that an effectively constant bias is maintained on V11a grid, and hence on the grid of the modulator, V2. This bias controls the standing current in the ferrite modulator, L3/L4 (see Section 1.2.3.), and hence the frequency of the swept oscillator.

If the mean swept output frequency tends to increase - due, for example, to a decrease in frequency of the fixed oscillator, V5 - the 60-kc/s point occurs earlier, i.e. at a lower voltage, in the initial build-up and the voltage across C9 falls. This reduces the bias on V2, with the result that the swept oscillator frequency decreases until equilibrium is restored.

If, on the other hand, the mean swept output frequency tends to decrease, the 60-kc/s point occurs later, i.e. at a higher voltage, in the initial build-up and the voltage across C9 increases. This increases the bias, raising the swept oscillator frequency to the point where equilibrium is again restored.

When the Generator is first switched on, there is no bias on V11a. Therefore the frequency of the swept oscillator is low, and, if the SWEEP WIDTH control is set near its minimum, the whole sweep may be below 60 Mc/s. The output will not then sweep through the a.f.c. range. This effect is avoided in the following manner.

The square wave existing across R27, in V3 anode, is rectified by diodes MR1 and MR2 to give approximately -20 volts d.c. which is applied to the grid of V2, via the SWEEP WIDTH control. This voltage is also absent when the Generator is first switched on and the grid of V2 is therefore less negative; the frequency of the swept oscillator is thus above 60 Mc/s. The negative voltage on the grid of V2 builds up slowly, due to the long time constant of the circuit, and the low-frequency end of the swept oscillator slowly falls until the lower limit of the output sweep extends down to 60 kc/s. As soon as this occurs, the a.f.c. takes control.

1.2.3. Modulator and Swept Oscillator

The sawtooth waveform applied to the grid of V2 causes a sawtooth current in the modulator coil, L3. This current produces a varying flux in the ferrite core of the oscillator coil, L4, and this causes

1.2.3. (continued)

the permeability of the core, and therefore the inductance of the oscillator tuned circuit, to vary in accordance with the applied sawtooth.

The reactor, L3/L4, is biased to work over its most linear range by the direct anode current of V2, supplemented by the bleed through R21 and RV4.

V3 is connected as a modified Colpitts oscillator tuned by L4, L5, and stray capacitances. It has a nominal frequency of 60 Mc/s, and the inductance variation produced by the ferrite reactor causes the frequency to sweep linearly from 60 Mc/s up to a maximum of 80 Mc/s. It is blanked off during alternate sweeps to provide a datum line for measurements. The blanking signal is fed to the junction of the diode, MR3, and the resistor, R25, its positive half-cycles being held at earth potential by the diode.

The oscillator is coupled to the buffer stage, V4, via a 60- to 80-Mc/s bandpass filter, L6, C22, L7.

1.2.4. Buffer Stage

V4 serves as a buffer between the swept and fixed oscillators, and also as the controlled valve in the a.g.c. system. It is a variable-mu valve, with the amplified a.g.c. voltage applied to the grid, the cathode being held at a constant potential by the cathode-follower V11b. V4 is coupled to the mixer stage, V6, via another 60- to 80-Mc/s bandpass filter.

1.2.5. Fixed Oscillator

The fixed oscillator, V5, is a conventional Hartley oscillator circuit resonant at 60 Mc/s.

1.2.6. Mixer

The output of the swept oscillator, operating over the frequency range 60- to 80-Mc/s, is connected, together with that of the 60-Mc/s fixed oscillator, to the grid of the mixer valve, V6. The difference frequency of 0 to 20 Mc/s is selected by the mixer anode circuit, which is a conventional video load incorporating combined shunt and series peaking.

1.2.7. Video Amplifier

Valves V6, V7, and V8 form a three-stage video amplifier, each stage having combined shunt and series peaking to maintain the high-frequency response up to 20 Mc/s. The series-peaking coil, L17, has optimum effect when the ratio between V8 output capacitance and V9 input capacitance is 1:2. This ratio is obtained by means of a small trimmer capacitor, C49, across the anode circuit of V8.

1.2.8. Output Stage and Attenuator

The output stage, V9, is transformer-coupled to the output attenuator. The a.g.c. system maintains the voltage across the secondary of the transformer constant, so that the effective output impedance at this point is zero. A 75-ohm resistor, R62, is connected in series with the input to the attenuator, so that the attenuator is fed from a source impedance of 75 ohms.

The attenuator consists of four 75-ohm sections of 2, 4, 6, and 8 dB respectively, each capable of being switched in or out, giving an attenuation range of 20 dB in 2 dB steps.

An OUTPUT LEVEL control (Section 1.2.9.) provides a ±1 dB adjustment of attenuation, thus acting as a fine control.

1.2.9. Internal Probe Circuit and A.G.C.

The voltage across the secondary of the output transformer, T2, is rectified by the double-diode detector, V14, and then amplified by V13 and applied as a.g.c. to the grid of V4. Due to the inherent delay around the a.g.c. loop, a high output spike would appear in the output at the start of the sweep, before the a.g.c. could gain control. To eliminate this, blanking from V10 is also applied to the a.g.c. amplifier and so shaped that it controls the rise of the signal at the start of each sweep.

V12b is an isolating diode which is biased by the potentiometer network R93, RV6, RV7, R95, the bias potential determining the level at which the a.g.c. operates and, therefore, the level of the output. The output level is set by means of RV7, with RV6 in its mid-position. RV6 then gives a ±1-dB adjustment of the output. V12a prevents the grid of V4 being taken positive with respect to cathode.

1.2.10. Blanking Generator

V1C is connected as a multivibrator, triggered by pulses from the screen of the time-base generator V1. This produces the blanking pulses required to blank off the sweep on alternate cycles of the time-base waveform. The width of the blanking pulse is adjusted by RV5 to be just within the sweep sawtooth. Blanking is applied to both the swept oscillator and the a.g.c. amplifier.

1.2.11. Marker Generator

The sweep output signal is applied to the control grid of a heptode valve, V15, whose first and second grids are connected as a 5-Mc/s crystal-controlled oscillator; the anode load consists of two resonant circuits, tuned to 1 Mc/s and 2 Mc/s respectively, and a CR network. The 5-Mc/s oscillation or its harmonics will produce zero beats as the sweep passes through 5, 10, 15, and 20 Mc/s; markers will thus be produced at these frequencies across R104 and C63. A voltage will be produced across the 1-Mc/s tuned circuit when the sweep signal differs from the above frequencies by 1 Mc/s, i.e. at 4, 6, 9, 11 Mc/s, etc., and, similarly, a voltage will be produced across the 2 Mc/s tuned circuit at 3, 7, 8, 12 Mc/s etc.; outputs will also be produced by the sweep signal direct at 1 Mc/s and 2 Mc/s.

All these signals are rectified by the diode, V25, to produce markers at every megacycle, and these are available at a separate outlet for use as a frequency scale on the c.r.o. A switch is provided for switching off the markers when not required.

1.2.12. Input and Output Probes

The input and output probes are connected to the input and output sockets, respectively, of the equipment under test. The output probe diodes are connected in the opposite sense to those of the input probe to provide signals of opposite polarity and, whereas the input probe places a high bridging impedance across the input to the equipment, the output probe has an impedance of 75 ohms to provide the correct termination for equipment having this output impedance.

When using the conventional method of response measurement (Section 2.6.1.) the input probe is not required.

1.2.13. Differential Mixer

The signals from the two probes are filtered by R125, C81, and R126, C82, respectively, and then fed to the two ends of a resistance chain consisting of RV10, R127, RV11, and R130. With switch SJ set to DIFF, the signals at either end of RV12 are balanced by means of RV10 when the inputs from the two probes are of the same amplitude. Thus there will be no signal applied to the grid of V23 when the slider of RV12 is set at its mid-position.

The variable resistor RV11 is adjusted so that RV12 covers ±1 dB over its calibrated range. Due to the inevitable non-linearity of the probe diode characteristics, the setting of RV11 will vary with the signal level applied to the probes. RV11 will, therefore, require resetting when changing from one output level to another. The other two positions of switch SJ, INPUT and OUTPUT, enable the signals from the input and output probes to be viewed separately.

Differencies in probe time-constants, due to resistance tolerances, etc., cause differences in the rise and fall times of the probe output signals, and spikes are produced at the start and finish of the sweep under balanced conditions. To minimise these spikes, the resistance to earth of the two probe signal paths can be balanced by RV9.

1.2.14. Mixer Amplifier

The output from the differential mixer circuit is amplified by V23 for application to the Y-plates of the oscilloscope. This output is in the form of a 25-c/s square wave. As any imperfections in the low-frequency response of the particular oscilloscope being used will detract from the accuracy of the Sweep Generator, an L.F. CORRECTION control, RV13, is provided. This control enables the falling response of the oscilloscope to be compensated for before making any measurements.

1.2.15. 1 dB Pad

A switched 1 dB pad, R119 - R121, is incorporated in the instrument to provide a means of accurately standardising the ±1 dB DIFFERENTIAL control.

1.2.16. Power Supply

The a.c. mains input is fed via the ON/OFF switch and fuses to a single transformer, T1. This transformer has suitable secondary windings to provide all the a.c. voltages required by the instrument.

1.2.16. (continued)

The filament supply for the probes is taken from a separate heater winding in order that the earthing point may be adjusted for minimum hum level.

The h.t. supply, derived from a centre-tapped winding, is applied to a full-wave rectifier valve, V16, and thence to a resistance-capacitance smoothing circuit. The d.c. voltage is regulated by a conventional series stabilizer circuit in which the grid voltage of a tetrode cathode-follower valve, V18, is controlled by a high-gain pentode amplifier, V19, the reference voltage level being provided by a gas-filled stabilizer, V20.

The primary connections of the mains transformer can be adjusted for any 40- to 100-c/s a.c. supply in the voltage ranges 100 - 150 volts and 180 - 250 volts. It must be noted, however, that in the INTERNAL position of the TRIGGER switch the time base will only function when 50- to 60-c/s a.c. supplies are in use.

2. OPERATION

2.1 INSTALLATION

Unless otherwise specified, the Sweep Generator is normally despatched with its valves and crystal in position and with its mains input circuit adjusted for immediate use with 240-volt a.c. mains supplies. The instrument may be adjusted for operation from any other supply in the voltage ranges 180 to 250 and 100 to 150 volts, and in the frequency range 40 to 100 c/s (subject to the limitation stated at the end of Section 1.2.16., page 13). To check or alter the setting of the mains transformer tappings, the user should refer to Section 4.2 - MAINS INPUT ARRANGEMENTS.

The TF 1099 has its mains lead brought out through the right-hand case-handle recess and is supplied complete with 3-pin plug. The TF 1099/1 is supplied with neither mains lead nor plug and the mains supply must be connected to plug PLH on the rear of the instrument using a suitable 4-way mating socket (F. and E. No. EP-4-15). Make connection as follows, using wire of at least 2-amp rating:

Earth: to pin 2
"Live": to pins 1 and 4.

To utilize this socket on the TF 1099, the user should refer to Section 4.2.4.

2.2 CONTROLS

Before switching on, the user should become familiar with the functions of the various controls. The preset controls will have been accurately set during manufacture and, with the exception of RV1, RV5, and RV9, which are mounted on the front panel of the instrument, will not need readjustment during normal use.

SUPPLY ON/OFF: (SG) — Controls the application of a.c. supply to the mains transformer.

SWEEP WIDTH: (RV3) — Varies the amplitude of the saw-tooth voltage applied to V2 grid, thus controlling the sweep width.
Note: the lower frequency limit of the sweep to some extent depends upon the sweep width; see Section 2.4.1. (11).

2.2. (continued)

OUTPUT LEVEL: (FV6)	Varies the a.g.c. bias and thus the output level. Its range is adjusted by means of the internal preset potentiometer, FV7, to be ±1 dB.
ATTENUATION: (SB, SC, SD, SE)	These four switches insert four attenuator networks in series with the sweep output, providing a total attenuation of 20 dB in 2-dB steps.
1 Mc/s MARKER ON/OFF: (SF)	When switched ON, marker pips are fed to the display oscilloscope where they provide a means of frequency identification.
TRIGGER INTERNAL/ EXTERNAL: (SA)	In the INTERNAL position, the sawtooth generator is triggered by the internal a.c. heater supply. In the EXTERNAL position, external pulses, fed via the TRIGGER INPUT socket, may be used to lock the sawtooth generator.
TIME BASE HOLD: (RV1)	Controls the frequency of the sawtooth generator, locking it to the mains supply or to external trigger pulses. It is adjusted to give maximum sawtooth amplitude consistent with satisfactory locking.
BLANKING WIDTH: (RV5)	Controls the mark/space ratio of the blanking pulses applied to the swept oscillator. When correctly adjusted, the blanking pulses only permit the swept oscillator to function every alternate cycle, during the run-down period of the modulating sawtooth waveform.
SELECT: (SJ) INPUT:	Feeds the signal from the input probe to the display oscilloscope.
OUTPUT:	Feeds the signal from the output probe to the display oscilloscope.

2.2. (continued)

DIFF.:	Selects the differentially combined signals from the two probes. When both probe output signals are of the same amplitude there is zero vertical deflection on the oscilloscope.
DIFFERENTIAL: (RV12)	Provides a means of adjusting the output to the c.r.o. over a calibrated range of ±1 dB. This allows measurement of small deviations from level of the frequency response of the equipment under test.
SET 1 dB: (RV11)	With switch SJ set to DIFF., the SET 1 dB control is adjusted to give the DIFFERENTIAL control a range of ±1 dB.
C.R.C. L.F. CORRECTION: (RV13)	Provides compensation for any falling-off in the low-frequency response of the display oscilloscope. It is adjusted to give a level base-line on the display.
BALANCE: (RV10)	Balances the two probe output signals. It is adjusted to give zero Y-deflection on the display oscilloscope when the two probes are connected to the same signal source.
PROBE EQUALIZER: (RV9)	This preset potentiometer is adjusted to minimize the output spikes which tend to appear at the ends of the trace due to differences in the probe time constants.

2.3. SWITCHING ON AND WARMING UP

Ensure that the instrument is correctly adjusted for the particular mains supply to which it is to be connected.

Then proceed as follows:-

(1) Connect the mains lead to the supply socket.

2.3. (continued)

(2) Switch the supply ON and note that the red indicator lamp glows.

(3) Before proceeding further, allow a few minutes for the valves to reach their correct operating temperature. It will be appreciated that, although the instrument may be used within, say, five minutes of switching on, at least fifteen minutes should elapse before making measurements requiring a high order of accuracy.

2.4. INITIAL ADJUSTMENTS

2.4.1. General

The following instructions refer to the general setting-up procedure of the Sweep Generator and should be carried out before any measurements are made with the instrument. They apply to all modes of operation.

(1) Set the TRIGGER switch to INTERNAL or EXTERNAL, depending upon the facility required. If external pulses are to be used they should be applied at the TRIGGER INPUT socket. They should have an amplitude of at least 2 volts negative with respect to earth.

NOTE:- In normal operation, the time base will invariably be switched to INTERNAL. In this case, the a.c. mains supply to the instrument must have a frequency of 50 to 60 c/s. The EXTERNAL position, however, may be used on occasions when the mains frequency fluctuates badly; it is also used when blanking and synchronizing signals are being mixed with the sweep signal to convert the latter into a standard television signal, as, for example, when measuring the frequency response of equipment incorporating black level clamp circuits.

If external pulses are not required ensure that the time base is switched to INTERNAL, otherwise operation will tend to be erratic.

(2) Connect the E and TIME BASE OUTPUT terminals to the earth and X-input, respectively, of the oscilloscope and adjust the TIME BASE AMPLITUDE control to the required level. The peak amplitude of the time base sawtooth is variable between approximately 190 and 280 volts.

2.4.1. (continued)

(3) Apply a signal of the same frequency as the trigger signal to the Y-input of the oscilloscope and adjust the preset TIME BASE HOLD control to maintain a steady trace on the oscilloscope.

(4) Disconnect the signal from the Y-input of the oscilloscope and connect the Y-input to the C. R. O. Y terminal.

(5) Connect the input and output probe leads to their respective four-pin sockets on the front panel of the Sweep Generator.

(6) Using the coaxial connector provided, couple the SWEEP OUTPUT socket to the socket on the input probe.

(7) Connect the input probe to one socket of the 1-dB pad, and the output probe to the other socket. Set the SELECT switch to OUTPUT.

(8) Switch the 1-dB pad out and adjust the C. R. O. L. F. CORRECTION control to give a flat top to the oscilloscope trace.

(9) Superimpose the markers on the trace, as described in Section 2.5.

(10) Set the SWEEP WIDTH control to maximum, i.e. fully clockwise.

(11) Adjust the screwdriver-operated preset BLANKING WIDTH control so that the 20-Mc/s marker appears at the extreme right-hand edge of the trace.

The sweep width now extends from its lower limit to its maximum value of 20 Mc/s. The lower limit depends to some extent upon the sweep width: for best accuracy, at sweep frequencies down to 100 kc/s the sweep width should not be more than 2 Mc/s; as the sweep width is turned to maximum the lower limit increases to 250 kc/s.

(12) Switch off the 1-Mc/s MARKERS and disconnect the probes from the 1-dB pad.

2.4.2. Differential Mixer Circuit

Before using the differential method of response measurement, the two probe outputs must be balanced and the DIFFERENTIAL control calibration must be standardized to provide an accurate indication of response deviation. The procedure for doing this is as follows :-

2.4.1. (continued)

(3) Apply a signal of the same frequency as the trigger signal to the Y-input of the oscilloscope and adjust the preset TIME BASE HOLD control to maintain a steady trace on the oscilloscope.

(4) Disconnect the signal from the Y-input of the oscilloscope and connect the Y-input to the C. R. O. Y terminal.

(5) Connect the input and output probe leads to their respective four-pin sockets on the front panel of the Sweep Generator.

(6) Using the coaxial connector provided, couple the SWEEP OUTPUT socket to the socket on the input probe.

(7) Connect the input probe to one socket of the 1-dB pad, and the output probe to the other socket. Set the SELECT switch to OUTPUT.

(8) Switch the 1-dB pad out and adjust the C. R. O. L. F. CORRECTION control to give a flat top to the oscilloscope trace.

(9) Superimpose the markers on the trace, as described in Section 2.5.

(10) Set the SWEEP WIDTH control to maximum, i.e. fully clockwise.

(11) Adjust the screwdriver-operated preset BLANKING WIDTH control so that the 20-Mc/s marker appears at the extreme right-hand edge of the trace.

The sweep width now extends from its lower limit to its maximum value of 20 Mc/s. The lower limit depends to some extent upon the sweep width: for best accuracy, at sweep frequencies down to 100 kc/s the sweep width should not be more than 2 Mc/s; as the sweep width is turned to maximum the lower limit increases to 250 kc/s.

(12) Switch off the 1-Mc/s MARKERS and disconnect the probes from the 1-dB pad.

2.4.2. Differential Mixer Circuit

Before using the differential method of response measurement, the two probe outputs must be balanced and the DIFFERENTIAL control calibration must be standar dized to provide an accurate indication of response deviation. The procedure for doing this is as follows :-

2.4.2. (continued)

(1) Set up the Generator as described in the preceding sections, leaving the probes connected to the 1-dB pad.

(2) Set the SELECT switch to DIFF. and the DIFFERENTIAL control to '0'.

(3) Adjust the BALANCE control until the two probe output signals are equal, giving zero Y-deflection on the oscilloscope.

(4) Adjust the screwdriver-operated preset PROBE EQUALIZER control to minimize the spikes at the beginning and end of the trace.

It may be necessary to repeat steps 3 and 4 above, alternately, until the correct settings are obtained.

(5) Switch IN the 1-dB pad and set the DIFFERENTIAL control to -1 dB.

(6) Adjust the SET 1 dB control until the two probe signals are again equal.

Note:- Due to the non-linearity of the probe diode characteristics, the required setting of the SET 1 dB control will vary with the signal level at which the probes are being used. It will therefore require resetting if the sweep output level is changed.

(7) Switch out the 1-dB pad and return the DIFFERENTIAL control to '0'. If necessary, readjust the BALANCE control and repeat steps 5 and 6, above, until the DIFFERENTIAL control calibration is in agreement with the 1-dB pad.

(8) Disconnect the probes.

This completes the preliminary setting-up of the Sweep Generator and the instrument is now ready for use.

2.5. USE OF FREQUENCY MARKERS

To enable the user to determine the frequency at which any response deviations occur, and to permit the accurate setting of the sweep to any

2.5. (continued)

width up to the maximum of 20 Mc/s, a series of 1-Mc/s markers may be superimposed as a frequency scale on the oscilloscope trace. The markers may be applied either as brightening pulses or, if using a double-beam oscilloscope, as Y-deflection pulses on the second trace. It should be noted, however, that deflection pulses cannot be used with a switched-beam oscilloscope, due to the time difference between the traces.

The procedure for each of these methods is detailed below.

2.5.1. Applying Brightening Markers

Connect the MARKER OUTPUT to the Z terminal of the oscilloscope. (As the amplitude of the marker pulses is only a nominal 1 volt peak, an oscilloscope incorporating a Z amplifier is normally required; the Marconi 17-inch oscilloscope Type TF 1159 fulfils this requirement.) Switch the 1 Mc/s MARKER ON. The number of markers appearing on the display will depend upon the setting of the SWEEP WIDTH control. The 5-, 10-, 15-, and 20-Mc/s markers, being beats, are readily identified by their flickering appearance.

2.5.2. Applying Deflection Markers to a Double-Beam Oscilloscope

Connect the MARKER OUTPUT terminal to the Y2 input of the oscilloscope and switch the 1 Mc/s MARKER ON. The markers will now appear on the second trace of the oscilloscope, the number appearing depending upon the setting of the SWEEP WIDTH control. The 5-, 10-, 15-, and 20-Mc/s markers being beats, are readily identified by their flickering appearance.

2.6. TO DISPLAY A FREQUENCY RESPONSE CURVE

The TF 1099 may be used for response measurements in either of two ways, depending on the nature of the response under investigation:-

(a) The conventional method, using one probe only, to sample the output signal of the apparatus under test. This method is suitable for displaying the overall response of video amplifiers, line equalizers, filters, etc., or when large deviations from level are to be examined or measured.

2.6. (continued)

(b) The differential method, using one probe to sample the input signal of the apparatus under test, and the other to sample the output signal. This method is intended for examining nominally flat sections of a response, and allows deviations of up to ±1 dB to be measured with a discrimination exceeding 0.01 dB and an accuracy that is independent of both the frequency response and output stability of the Sweep Generator.

Both of these methods are described in the following sections.

2.6.1. The Conventional Method

(1) Carry out the initial setting-up procedure laid down in Section 2.4.1.

(2) Couple the SWEEP OUTPUT socket to the input socket of the apparatus under test, using the coaxial connector provided.

(3) Connect the output probe lead to the four-pin OUTPUT PROBE socket on the front panel of the Generator.

(4) Connect the input plug of the output probe to the output of the apparatus under test, and set the SELECT switch to OUTPUT.

(5) Adjust the SWEEP WIDTH control as required.

(6) By means of the ATTENUATION switches adjust the sweep output to the level required; use the OUTPUT LEVEL control for fine adjustment. The signal applied to the probe input should not be allowed to exceed 3 volts peak-to-peak.

The ATTENUATION and OUTPUT LEVEL controls may also be used to measure deviations in frequency response between 1 and 20 dB, as follows:-

(1) Display the frequency response curve of the equipment under test as described at the beginning of this section. With no attenuation in the Sweep Generator output, note the height of the top of the curve. If no graticule is fitted to the oscilloscope the window should be lightly marked with a Chinagraph pencil.

(2) Reduce the output level 1 dB at a time, and at each 1-dB point again mark the height of the trace.

2.6.1. (continued)

(3) Remove all the attenuation from the Sweep Generator output.

(4) With the response curve again displayed at its full height on the screen, the amplitude of any irregularities in the curve may be approximately measured against the 1-dB points.

2.6.2. The Differential Method

(1) Carry out the initial setting-up procedure laid down in Sections 2.4.1 and 2.4.2, using the signal level which is to be employed during the measurements.

(2) Connect the input and output probes to their respective four-pin sockets on the front panel of the instrument.

(3) Couple the SWEEP OUTPUT socket to the socket on the input probe with the coaxial connector provided.

(4) Set the SELECT switch to DIFF.

(5) Connect the input probe to the input socket of the amplifier under test, and the output probe, via an external adjustable attenuator, to the output socket of the amplifier.

(6) Set the SWEEP WIDTH control to its minimum position, i.e., fully counter-clockwise.

(7) Adjust the external attenuator to reduce the overall amplifier gain to unity, i.e., to give zero vertical deflection on the oscilloscope.

(8) Set the SWEEP WIDTH control to provide the desired amount of sweep. The frequency markers (Section 2.5) will be found invaluable as a means of determining the actual sweep width selected.

The deviations in frequency response of the amplifier will now be displayed on the oscilloscope as deflections of the trace about the base line.

(9) To measure the deviation from level of any point on the response, move the trace up or down with the DIFFERENTIAL control until the point under investigation coincides with the base line. The reading indicated by the DIFFERENTIAL control is the deviation from level of the response at that point.

OPERATIONAL SUMMARY

When the user is familiar with the principles and techniques of operation detailed in the preceding sections of this handbook, the following abridged operating instructions may be found convenient.

Sweep Output

Sweep Width:	Below 100 kc/s up to a maximum of 20 Mc/s; see Sect. 2.4.1.(11).
Output Level:	0.3 to 3 volts peak-to-peak. Constant to within ±0.1 dB.
Output Impedance:	75 ohms.

Time Base

Trigger:	Internal, or externally by 50- to 60-c/s negative pulses having an amplitude of at least 2 volts.
Output:	Approximately 250 volts.

Markers	Available at 1-Mc/s intervals from 1 to 20 Mc/s at a nominal level of 1 volt.
Power Supplies	100 to 150 volts or 180 to 250 volts, 40 to 100 c/s. (50 to 60 c/s when using internal time base trigger).

BEFORE SWITCHING ON

Be sure the mains input circuit is correctly adjusted.

SETTING UP - GENERAL

Connect TIME BASE OUTPUT to oscilloscope X-plates, and C.R.O. Y and E to oscilloscope Y-plates and earth respectively. Set TRIGGER to INTERNAL or EXTERNAL, as required. Adjust TIME BASE HOLD for steady trace. Connect probes to 1-dB pad and SWEEP OUTPUT to socket on input probe. SELECT OUTPUT

3. (continued)

and switch 1-dB pad out. Adjust C.R.O. L.F. CORRECTION for level trace.

(For further details see Section 2.4.1.)

SETTING UP - DIFFERENTIAL MIXER

SELECT DIFF. and set DIFFERENTIAL to "0". Set BALANCE for zero Y-deflection and adjust PROBE EQUALIZER to minimize spikes. Switch IN 1-dB pad and set DIFFERENTIAL to -1 dB. Adjust SET 1 dB for zero Y-deflection.

(For further details see Section 2.4.2.)

TO SUPERIMPOSE MARKERS

Connect MARKER OUTPUT terminal to Y2 or Z input of oscilloscope and switch ON 1 Mc/s MARKER.

(For further details see Section 2.5.)

TO DISPLAY RESPONSE (CONVENTIONAL METHOD)

Connect SWEEP OUTPUT to amplifier input, and output probe to amplifier output. SELECT OUTPUT. Adjust SWEEP WIDTH and OUTPUT LEVEL as required.

(For further details see Section 2.6.1.)

TO MEASURE DEVIATION (DIFFERENTIAL METHOD)

Connect SWEEP OUTPUT to socket on input probe. SELECT DIFF. Connect input probe, via external attenuator, to amplifier output. Set SWEEP WIDTH to minimum and adjust external attenuator for zero Y-deflection. Set SWEEP WIDTH to desired position and adjust DIFFERENTIAL for zero Y-deflection. DIFFERENTIAL setting indicates deviation of response from level.

(For further details see Section 2.6.2.)

4. MAINTENANCE

4.1. GENERAL

The following items are included in this handbook to assist in the maintenance of the Sweep Generator:

Circuit Diagram
Block Schematic
Component Layout Illustrations
Spares Ordering Schedule, with
Circuit References
Valve Replacement Data Sheets
Mains Input Connection Diagram
Test Point Data and Response Diagram

Section 1, DESCRIPTION, of this handbook deals with the internal circuits of the Sweep Generator and is intended to be read in conjunction with the Block Schematic Diagram. It is strongly recommended that, before commencing the adjustment or replacement of component parts of the instrument, the user should familiarise himself with the principles described in Section 1 and illustrated in the Block Schematic.

The complete Circuit Diagram shows all the electrical components contained in the instrument. The description of these components - their type, value, rating, etc. - is given in the Spares Ordering Schedule; the Schedule also lists certain mechanical components.

The physical locations of the electrical components are shown in the Component Layout Illustrations.

4.2. MAINS INPUT ARRANGEMENTS

4.2.1. General

The instrument is fitted with a mains transformer having a double-wound primary, the two tapped sections of which can be connected in series or series-parallel to permit operation from any 40- to 100-c/s supply within the ranges 180 to 250 volts or 100 to 150 volts. (See Section 1.2.16.) The following description and instructions concerning connections to the transformer should be read in conjunction with the Mains Input Connection Diagram following page 26.

4.2.1. (continued)

The supply input to the transformer is carried by two fly leads which are connected by screws to a tapping panel mounted at the rear of the instrument. Attached to the tapping panel is a pierced reference plate, which is reversible and marked with a selection of voltages. On one side of the plate, the voltages are applicable to the 100- to 150-volt range; on the other side, to the 180- to 250-volt range. The 100-volt sections of the two primary windings are connected in series, or parallel, by one, or two, links soldered between tags mounted directly on the transformer coil. To change from one range to the other, the link between the transformer tags is altered; to make a small change within one of the major ranges, one or both of the screw-secured fly leads on the tapping panel are moved to a fresh position.

In order to examine the transformer connections, remove the case from the instrument as described in Section 4.4.1. If it is only required to alter or view the position of the fly leads on the tapping panel, the case need not be removed; instead, DISCONNECT THE SUPPLY and remove the rectangular cover-plate on the back of the instrument.

4.2.2. Operation from 180- to 250-volt, 40- to 100-c/s Supplies

To adjust the instrument to operate from 180- to 250-volt supplies, connect the link on the transformer coil and the link from the mains tapping panel as shown in figure 1 of TLC 27612. Adjust the position of the fly leads to the mains tapping panel as necessary.

4.2.3. Operation from 100- to 150-volt, 40- to 100-c/s Supplies

To adjust the instrument to operate from 100- to 150-volt supplies, connect the links on the transformer coil and the lead from the mains tapping panel as shown in figure 2 of TLC 27612. Adjust the position of the fly leads to the mains tapping panel as necessary.

4.2.4. Mains Input Connection on the TF 1099/1

The a.c. mains supply to the TF 1099/1 is fed to the mains transformer via plug FLH on the rear of the instrument. For the appropriate pin connections refer to Section 2.1.

On the TF 1099 this plug is fitted but not connected to the mains transformer. If required, the mains supply may be taken via plug FLH rather than the normal mains lead after carrying out the wiring modifi-

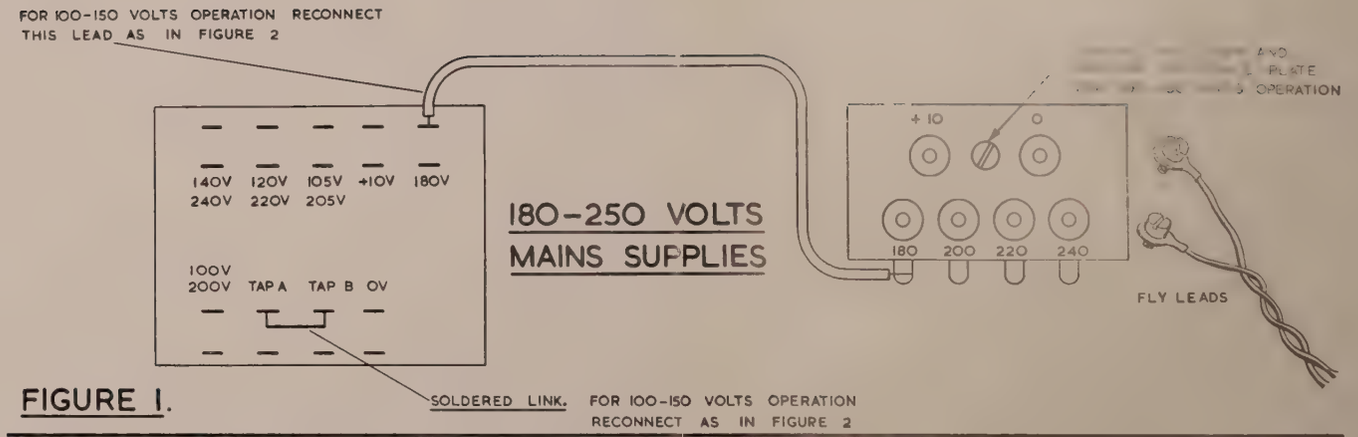
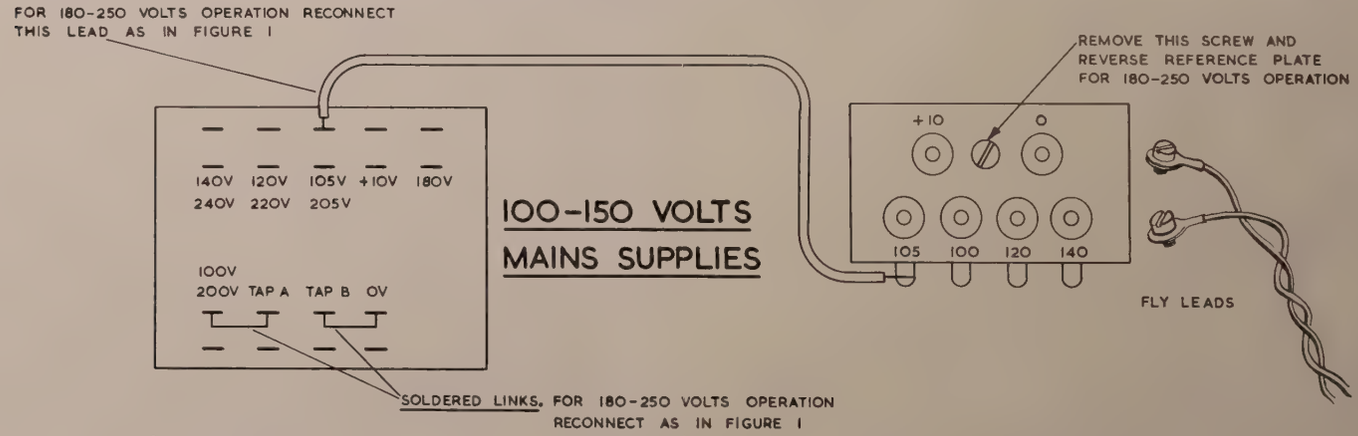

FOR 100-150 VOLTS OPERATION RECONNECT THIS LEAD AS IN FIGURE 2
140V 120V 105V +10V 180V
240V 220V 205V
100V
200V TAP A TAP B 0V
180-250 VOLTS MAINS SUPPLIES
+10
0
180 200 220 240
FLY LEADS
SOLDERED LINK. FOR 100-150 VOLTS OPERATION RECONNECT AS IN FIGURE 2

FIGURE 1.


FOR 180-250 VOLTS OPERATION RECONNECT THIS LEAD AS IN FIGURE 1
140V 120V 105V +10V 180V
240V 220V 205V
100V
200V TAP A TAP B 0V
100-150 VOLTS MAINS SUPPLIES
REMOVE THIS SCREW AND REVERSE REFERENCE PLATE FOR 180-250 VOLTS OPERATION
+10
0
105 100 120 140
FLY LEADS
SOLDERED LINKS. FOR 180-250 VOLTS OPERATION RECONNECT AS IN FIGURE 1

A ARRANGEMENT OF PRIMARY SOLDER TAG CONNECTIONS ON MAINS TRANSFORMER

B MAINS TAPPING PANEL
CONNECT THE FLY-LEADS TO GIVE A COMBINATION TO SUIT MAINS VOLTAGE.
ONE FLY-LEAD MUST GO TO EITHER '+10' OR '0' TAP

FIGURE 2.

MAINS INPUT CONNECTIONS

TLC 27612

4.2.4 (continued)

cations detailed below. It should be noted, however, that the instrument must then be rack-mounted as the instrument case, when fitted, does not allow access to the plug.

(1) Remove the mains input lead by unscrewing terminals 3, 4 and 5 of the 5-way terminal block. This block is located behind the SUPPLY ON/OFF switch.

(2) Disconnect the SUPPLY ON/OFF switch leads from terminals 3 and 4, and reconnect to terminals 1 and 2.

4.3 REPLACEMENT OF FUSES

The mains input and h.t. circuits of the Sweep Generator are protected by three cartridge fuses; two 2-amp in the supply lines and one 250-mA in the mains transformer h.t. centre tap line. These fuses are located behind the small rectangular cover plate on the back of the instrument and can be replaced without removing the instrument from its case. When replacing a fuse, always ensure that a fuse of the correct value is fitted.

The fuses are adequately rated for both the 180- to 250-volt and 100- to 150-volt ranges.

4.4 DISMANTLING THE INSTRUMENT

4.4.1 Removal of Case

This section applies only to the TF 1099. The TF 1099/1 is supplied less case.

To remove the case, first lay the Sweep Generator face downwards on a bench and remove the two metal runners upon which the instrument normally stands - each of these is secured by two screws, one at each end of the runner. Next remove the upper two metal domes at the back of the instrument - each of these domes is held at its centre by a countersunk screw. The rear section of the case can now be separated from the main body of the instrument. The mains supply lead passes through the inside of the instrument via a cut-out in the left-hand case-handle recess; feed the cable through as the rear section of the case is lifted upwards.

4.4.1. (continued)

The front section of the case remains, framing the front panel. This section does not prevent access to the interior of the instrument, but may be removed, if necessary, by withdrawing the twelve screws which can now be seen, holding it to the periphery of the front panel.

4.4.2. Access to Valves and Crystal

The types of valves used in the instrument, their base connections, and some guidance as to suitable alternatives if the types originally fitted are not readily available, are given in the Valve Replacement Data Sheets.

The valves may normally be replaced without special selection. All valves except V21, V22 and V23 are mounted on the main chassis. To gain access to the valves, remove the two chassis-securing pillars and swing the main chassis backwards, exposing the valves and crystal. V23 is mounted on the mixer-amplifier sub-chassis located behind the panel lamp. V21 and V22 are mounted inside the probe assemblies and may be removed as described in Section 4.4.5.

The pilot lamp is accessible after removing the red translucent cover on the front panel.

The crystal is located near the mains transformer on the main chassis.

The circuit is designed so that only exceptionally will changing a valve necessitate the resetting or reselection of associated components. Nevertheless the possibility of such adjustment being necessary should be borne in mind; aspects of resetting procedure are dealt with in Section 4.6.

4.4.3. Oscillator Unit Cover

The components, other than valves, of the buffer and oscillator stages are housed in the screened compartment on the main chassis. To gain access to these components, remove the seven cheese-head screws from the top of the cover, and slacken the five cheese-head screws from the side; the latter are accessible through holes in the side of the main chassis.

4.4.4. Mixer Amplifier Chassis

The mixer amplifier is mounted on a separate sub-chassis behind the panel lamp. To gain access to the components mounted on it, swing back the chassis (Section 4.4.2). If necessary, the sub-chassis may be detached by first removing V23 and then unsolding the leads connecting the mixer amplifier to the remainder of the circuit; next take out the six instrument-head screws holding the sub-chassis to the front panel and the three countersunk screws holding it to the side-member.

4.4.5. Probe Covers

Remove the two small countersunk screws at the side of the probe cover, one at either end. Do NOT remove the screws fitted to the end-plates of the probe. The cylindrical cover may now be drawn off, giving access to all components mounted in the probe.

4.5. WORKING VOLTAGES

The voltages given in this section are for guidance when servicing the instrument and were obtained from a representative Sweep Generator Type TF 1099. The voltmeter used had a resistance of 20,000 ohms per volt.

The TRIGGER switch, 5A, was set to INTERNAL, and the 1 Mc/s MARKER switched ON.

Power Supply Voltages

H.T. a.c. (between anodes of V16 and chassis)	370-0-370 V a.c.
H.T. rect. (between cathode of V16 and chassis)	400 V d.c.
H.T. reg. (between cathode of V18 and chassis)	*250 V d.c.
H.T. stab. (between anode of V17 and chassis)	150 V d.c.
Control valve (V19):	
Between anode and chassis	242 V d.c.
Between screen and chassis	109 V d.c.
Between cathode and chassis	83 V d.c.
LT1 (measured at transformer tags)	5.0 V a.c.
LT2 (measured at transformer tags)	6.3 V a.c.
LT3 (measured at transformer tags)	6.3 V a.c.
LT4 (measured at transformer tags)	6.3 V a.c.

* adjusted by means of RV8

4.5. (continued)

Electrode Voltages

Valve	Anode	Screen	Cathode
1	177	158	0
2	226	-	8.7
3	240	211	0
4	249	148	80
5	210	145	0.9
6	138	146	3.6
7	180	130	2.1
8	185	130	1.8
9	245	250	7.4
10a	241	-	44
10b	158	-	44
11a	70.5	-	0
11b	249	-	80
13	37.5	80	8.3
15	224	147	5
23	125	156	1.8
24	213	139	3.4

4.6. PRESET AND SPECIALLY SELECTED COMPONENTS

During factory calibration, many of the performance characteristics of the Sweep Generator are brought within close limits by means of preset controls or, in one instance, by choosing the value of a specially selected component (P9).

Following replacement or aging of certain fixed components in circuits whose performance depends on the adjustment of a preset or the value of the selected component, it is essential to repeat the calibration procedure by which the preset was originally adjusted or the value of the selected component chosen. For example, replacement of C64 in V15 anode circuit will necessitate readjustment of L19 in order to restore the resonant frequency of the tuned circuit to 1 Mc/s.

4.6. (continued)

The section dealing with the calibration procedure appropriate to each preset and selected component is indicated in Table 1. The procedure referred to should also be carried out in the event of replacement of any of these components.

TABLE 1

Preset Component	Section Describing Adjustment
RV4	4.7.5.
RV7	4.7.9.
RV8	4.7.3.
RV14	4.7.13.
C22	4.7.5.
C27	4.7.6.
C33	4.7.5.
C49	4.7.8.
L5	4.7.5.
L6	4.7.5.
L7	4.7.5.
L9	4.7.5.
L10	4.7.5.
L12	4.7.8.
L13	4.7.8.
L14	4.7.8.
L15	4.7.8.
L16	4.7.8.
L17	4.7.8.
L19	4.7.7.
L20	4.7.7.

Selected Component	Section Describing Selection
R4	4.7.5.

4.7. SCHEDULE OF TESTS

The following sections, based on the factory test schedule, are included to enable the user to carry out a series of tests by which the main points of performance of the instrument can be checked. The sections also give details of the procedures adopted where special adjustments or calibrations are made on each individual instrument, e.g., the setting of preset components.

4.7. (continued)

It should be noted that a number of tests require the removal of certain components and the addition of others, e.g., load resistors, before the test can be carried out. The circuit changes required for any specific test are enumerated at the beginning of each section. After the test has been carried out the circuit must be returned to its original state, unless any subsequent test necessitates the same changes.

4.7.1. Apparatus required

(a) 500-volt Insulation Tester.

(b) Variable Mains Transformer. The output should be continuously variable over one or other of the mains voltage ranges of the Sweep Generator.

(c) Multi-range D.C. Voltmeter.

(d) Double-Beam Cathode-Ray Oscilloscope. This should be calibrated for voltage measurement at 50 c/s and also standardized at 3 volts, 500 kc/s.

(e) Probe Unit, as shown in Drawing No. TLC 28086.

(f) Standardized Variable Attenuator; 75 ohms impedance, for use up to 20 Mc/s; Marconi Type TF 1073.

(g) Communications Receiver covering the range 3 to 10 Mc/s.

(h) Source of 0.8 volt of high stability, e.g., a battery and a potentiometer.

(j) 68-kΩ Fixed Resistor, $\frac{1}{2}$-watt rating.

(k) 50-kΩ Potentiometer.

(l) 47-μμF Fixed Capacitor, 250 volts d.c. working.

(m) Audio Oscillator or Pulse Generator covering the range 50 to 60 c/s at an output level of 3 volts; Marconi Types TF 1101, TF 195 (Series) or TF 885 (Series) (Audio); Marconi Type 675F (Pulse).

4.7.1. (continued)

(n) Signal Generator covering the frequencies 1, 2, and 20 Mc/s at an output level of 1 volt; Marconi Type TF 144 (Series) or TF 867.

(p) Signal Generator covering the frequency range 55 to 85 Mc/s; Marconi Types TF 995 (Series), TF 801 (Series) or TF 1066 (Series).

4.7.2. Insulation (Apparatus required: Item a)

With the SUPPLY switch ON, but with no connection made to the supply, measure the insulation between each "live" pin of the mains plug and chassis. The insulation is normally greater than 40 MΩ.

4.7.3. Power Unit (Apparatus required: Items b, c and d)

Connect the instrument to the mains supply via the variable-output transformer. Set the transformer so that the effective supply voltage is exactly the value to which the Sweep Generator is adjusted on its tapping panel.

Measure the voltage between the cathode of V18 and chassis; it should be 250 V d.c. ±5%; if it is not, adjust RV8. Measure the voltage between pin 1 of V17 and chassis; it should be 150 V d.c. ±5%.

Connect the c.r.o., via a d.c. blocking capacitor, to the 250-volt h.t. line; vary the supply voltage to the Sweep Generator by ±6% and check that the hum level does not rise above approximately 8 mV peak-to-peak. Repeat this test on the 150-volt line; a typical maximum hum level at this point is approximately 80 mV peak-to-peak.

Connect the voltmeter across V17; vary the supply voltage ±6% and check that the 150-volt line does not vary by more than about ±1%.

4.7.4. Waveform Generators (Apparatus required: Items c, d and m)

Set the oscilloscope with its time base running at half the mains supply frequency, and locked to the mains supply; connect the Sweep Generator TIME BASE OUTPUT to the Y-input terminal of the oscilloscope.

4.7.4. (continued)

Synchronization

(1) Remove V13.

(2) Set switch SA, TRIGGER, to INTERNAL and adjust RV1, the TIME BASE HOLD control, until the Sweep Generator time base is running at the mains frequency, and locked to the mains supply; this condition is indicated by the appearance of two complete sawtooth cycles on the oscilloscope screen.

(3) Disconnect the oscilloscope Y-input from the TIME BASE OUTPUT terminal.

(4) Using the oscilloscope, check that the waveform at point A on the circuit diagram corresponds in shape and amplitude to that shown on Drawing No. TLC 28086.

(5) Check that at least 250 volts peak-to-peak are available at the TIME BASE OUTPUT terminal.

Blanking Generator

(6) Check that the waveform at point E on the circuit diagram corresponds to that shown on TLC 28086.

(7) Check that the BLANKING WIDTH control varies the width T (TLC 28086-B) over a range of approximately 10 to 15 msec.

Note: To check the waveform generators at any frequency within the range 50 to 60 c/s, other than that of the mains supply, proceed as follows:-

(8) Set switch SA to EXTERNAL and apply the signal from the audio oscillator to the TRIGGER INPUT socket. Trigger the oscilloscope from the audio oscillator simultaneously and set the oscilloscope time base to half the audio oscillator frequency. Check that the Sweep Generator still passes tests 4 to 6 above. The BLANKING WIDTH control should now alter the width T (TLC 28086-B) over a range of approximately 8 to 12 msec.

4.7.5. Swept Oscillator (Apparatus required: Items c, d, e, h, j, k, l and p)

(1) Remove valves V7 and V13; disconnect C8 and MR4 from R16 and R12, and apply 0.8 volt, negative with respect to earth, across R16.

(2) Connect a 68-kΩ resistor in series with a 50-kΩ potentiometer and connect the two between the anode pin of V13 and earth. Adjust the potentiometer for maximum signal, without overloading, at point 2.

(3) Set RV3 to maximum, i.e., 20 Mc/s sweep, and check that the waveform and voltage at the cathode of V2 (point L) are as given on TLC 28086.

(4) Check that the waveforms at points B, C, and K agree with those given on TLC 28086.

(5) Adjust RV4, the "set zero" control, until the voltage drop across R24 is 17 volts.

NOTE: If any of the waveforms or voltages specified above can not be obtained, the following test should be carried out:

Connect the oscilloscope to the junction of R27 and R28. The correct waveform is shown on TLC 28086-A. The amplitude of this waveform should be 23 volts peak-to-peak. If this waveform is correct, but the other waveforms still can not be obtained, V2 should be changed. If the waveform is not correct, then the fault can only lie in the chain RV4, R21, R22, L3, R23, R24 and these components and their associated wiring should be checked.

When the above tests have been carried out satisfactorily, proceed as follows:-

(6) Connect the TIME BASE OUTPUT of the TF 1099 to the X-input of the oscilloscope, and the test probe (TLC 28086) to the Y-input.

(7) Connect this test probe to point 1 on the circuit diagram. A waveform similar to that on TLC 28086-A should be obtained, but the top may not be flat as L6, C22, and L7 have yet to be adjusted.

4.7.5. (continued)

(8) Set up the signal generator, Item p, to any frequency within the range 60 to 80 Mc/s and apply a 100-mV signal, via a 47-μμF capacitor, to the same point as the test probe, i.e., point 1. The addition of this signal will cause distortion of the trace (see TLC 28086). When the frequency of the swept oscillator passes through the frequency of the signal generator, a "blip" is seen on the trace. As the generator frequency is changed, the "blip" is seen to move along the trace.

(9) Set the signal generator to a frequency of 60 Mc/s and adjust L5 until the "blip" is at the extreme left-hand edge of the trace.

(10) Increase the signal generator frequency until the "blip" is at the extreme right-hand edge of the trace. Adjust the BLANKING WIDTH control so that this occurs at a signal generator frequency of 80 Mc/s. The Sweep Generator is now sweeping over a range of 20 Mc/s. If a 20 Mc/s-sweep can not be obtained select a new value for R9.

(11) Remove the signal generator from point 1.

(12) Remove V4 and adjust L6, C22, and L7 until the trace has a flat top.

(13) Replace V4 and remove V6.

(14) Transfer the test probe to point 2 and adjust L9, C33, and L10, until the trace again has a flat top.

4.7.6. Fixed Oscillator (Apparatus required: Items c, d, e, h, j and k)

(1) Carry out steps 1 to 6, inclusive, of Section 4.7.5. - Swept Oscillator.

(2) Connect the test probe to point 4 and adjust C27 until the zero beat (a deep dip in the trace) appears at the left-hand edge of the trace. (See TLC 28086).

(3) Remove V3 and check that the output voltage from the fixed oscillator (pin 5 of V5) is 0.64 volt ±10%.

4.7.7. Marker Oscillator (Apparatus required: Items d and n)

(1) Connect the output probe lead to its four-pin socket on the front panel of the Sweep Generator and the output probe plug, PLB, to the SWEEP OUTPUT socket.

(2) Connect the Y1-input of the oscilloscope to the C.R.O. terminals and the Y2-input to the MARKER OUTPUT terminal.

(3) Set switch SJ to OUTPUT and switch ON the 1 Mc/s MARKER.

(4) Set the sweep to about 5 Mc/s and feed a 1-Mc/s signal from the external generator to the grid of V7.

(5) Tune L19 to 1 Mc/s and lock the core.

(6) Change the frequency of the external generator to 2 Mc/s and tune L20 to 2 Mc/s. Lock the core.

(7) Set the SWEEP WIDTH to maximum, i.e. 20 Mc/s, and check that the 10-Mc/s marker is within ±5% of the mid-point of the trace. If any non-linearity is apparent, readjust RV4 and L5 to obtain good linearity while maintaining zero-hold.

4.7.8. Video Amplifier (Apparatus required: Items d, e, h, j and k)

(1) Remove V13 and connect a 68-kΩ resistor, in series with a 50-kΩ potentiometer, between the anode pin and chassis.

(2) Disconnect C8 and MR4 from R16 and R12, and apply 0.8 volt, negative with respect to earth, across R16.

(3) Connect the TIME BASE OUTPUT to the X-input of the oscilloscope.

(4) Connect the output probe to the SWEEP OUTPUT socket and disconnect C47.

(5) Connect the oscilloscope, via the test probe (TLC 28086), to point 5 on the circuit diagram and adjust L12 and L13 to obtain a substantially flat top to the response curve.

(6) Replace C47 and remove C48.

4.7.8. (continued)

(7) Transfer the probe to point 6, and adjust L14 and L15 to obtain a substantially flat top to the response curve.

(8) Replace C48 and remove C50.

(9) Transfer the probe to point 7, and adjust L16, L17 and C49. The response of this stage should be allowed to fall to about -3 dB at 20 Mc/s. See TLC 28086.

(10) Return the circuit to its original state.

(11) Check that the overall response, measured with the output probe connected to the SWEEP OUTPUT socket, is flat to within ±0.1 dB from 60 kc/s to 20 Mc/s.

4.7.9. A.F.C. and A.G.C. Systems (Apparatus required: Item d)

(1) Connect the TIME BASE OUTPUT to the X-input of the oscilloscope, and connect the output probe to the SWEEP OUTPUT socket. This provides the correct 75-ohm termination for the Sweep Generator.

(2) Connect the terminated output of the Sweep Generator to the Y-input of the oscilloscope.

(3) Set RV6, the OUTPUT LEVEL control, to "0", and the SWEEP WIDTH control, RV3, fully anti-clockwise, i.e. minimum sweep.

(4) With no ATTENUATION in the output, adjust RV7 to give an output voltage of 3 volts peak-to-peak.

4.7.10. Attenuator (Apparatus required: Items d and f)

(1) Connect the Sweep Generator, via the external attenuator, to the Y-input of the oscilloscope, using the shortest possible leads.

(2) Set the OUTPUT LEVEL control to "0" and the SWEEP WIDTH control to minimum.

(3) Switch in 20 dB attenuation on the Sweep Generator and set the external attenuator to 0 dB.

4.7.10. (continued)

(4) By means of the controls on the oscilloscope, adjust the display to a convenient height. Note this height, either by reference to the graticule or by marking the c.r.t. window.

(5) Switch out the Sweep Generator attenuator in steps of 2 dB, at the same time switching in the standard attenuator by the same amount. Verify that the height of the display remains constant.

4.7.11. Internal Probe Circuit (Apparatus required: Item d)

Observe the signal from socket SKT C on the oscilloscope. Check that it is flat to within ±0.1 dB over the whole sweep of 100 kc/s to 20 Mc/s.

4.7.12. 1-dB Pad (Apparatus required: Items d, f and n)

Connect the signal generator to one socket of the 1-dB pad, and the oscilloscope input to the other. With the 1-dB pad switched out and with 1 dB attenuation in the signal generator output, note the height of the display. Switch out the signal generator attenuation and switch IN the 1-dB pad. Verify that the height of the display remains substantially constant.

4.7.13. Differential Mixer (Apparatus required: Item d)

(1) Switch out the 1-dB pad and connect the input and output probes to the two 1-dB pad sockets.

(2) Connect the TIME BASE OUTPUT to the X-input of the oscilloscope and the C.R.O. Y terminal to the Y1-input.

(3) Couple the SWEEP OUTPUT socket to the socket on the input probe, using the coaxial connector, and set the SELECT switch, SJ, to OUTPUT. The signal from the output probe should now appear on the oscilloscope.

(4) Set the sweep to approximately 1 Mc/s and adjust the C.R.O. L.F. CORRECTION control to give a flat trace. Increase the sweep to a maximum and check that the response is still substantially flat.

4.7.13. (continued)

(5) To check the signal from the input probe set the SELECT switch to INPUT. This signal will be of opposite polarity.

(6) Set the SELECT switch to DIFF. and the DIFFERENTIAL control to "0".

(7) Adjust the BALANCE control until the two probe signals are equal and give zero vertical deflection on the oscilloscope.

(8) Adjust the PROBE EQUALIZER control, RV9, to minimize the spikes at the ends of the trace. It may now be necessary to re-adjust the BALANCE control.

(9) Switch IN the 1-dB pad and set the DIFFERENTIAL control to -1 dB. Adjust the SET 1 dB control to give zero vertical deflection on the oscilloscope.

(10) Switch out the 1-dB pad and return the DIFFERENTIAL control to "0". If necessary, rebalance by means of RV10 and repeat step 9, above, until the calibration of the DIFFERENTIAL control agrees with the 1-dB pad. This calibration will vary with signal level and should be checked at several levels to ensure that the controls cover a sufficient range.

(11) Disconnect the output probe from the 1-dB pad, and the TIME BASE OUTPUT from the X-input of the oscilloscope.

(12) Adjust RV14 to minimize the hum on the mixer amplifier output.

4.7.14. Harmonic Distortion (Apparatus required: Items d, f and g)

(1) Connect the Sweep Generator, via the external attenuator, to the aerial terminals of the receiver. Connect the oscilloscope to the receiver output.

(2) Tune the receiver to a frequency of 12 Mc/s and set the SWEEP WIDTH control so that the Generator just sweeps through this frequency. Adjust the attenuator to prevent overloading of the receiver. At least 40 dB of attenuation should be included.

(3) As the sweep passes through 12 Mc/s, a "pip" will be produced on the oscilloscope trace. Note the amplitude of this "pip".

4.7.14. (continued)

(4) Reduce the sweep width slightly so that the receiver frequency is just outside the sweep.

(5) Reduce the attenuator setting until further "pips" appear, this time at 6 and 4 Mc/s. Note the amount by which the attenuation has to be reduced in order to bring the amplitude of these harmonic "pips" up to the level of that at 12 Mc/s. This gives the second and third harmonic figures directly in decibels.

Convert these figures into voltage ratios, E_2 and E_3, by referring to the Decibel Conversion Table at the end of this handbook. The total harmonic content, i.e.

$$\sqrt{E_2^2 + E_3^2} \times 100\%$$

should not exceed 2%. It should be noted that harmonics of frequencies above 12 Mc/s will be sufficiently attenuated by the output transformer frequency response.

4.7.15. Waveforms

Check that the waveforms at all points marked on the circuit diagram correspond with the figures given on TLC 28086. The waveforms not previously mentioned are intended primarily as an aid to fault-finding.

APPENDIX

VALVE REPLACEMENT DATA ..... TBL DWG -1

COMPONENT LAYOUT ILLUSTRATIONS

Front View ..... MP DWG -1
Rear View - Chassis Cover In ..... MP DWG -2
Rear View - Chassis Flipped Down ..... MP DWG -3
Main Chassis - Upper Section ..... MP DWG -4
Main Chassis - Lower Section ..... MP DWG -5
Main Chassis - R. F. Section ..... MP DWG -6

PARTIAL ORDERING INFORMATION WITH CIRCUIT REFERENCES ..... SCH DWG -1

BLOCK SCHEMATIC DIAGRAM ..... BLC DWG

CIRCUIT DIAGRAM ..... SD DWGS

TEST WAVEFORM DIAGRAM ..... TWC DWG

DECIBEL CONVERSION TABLE ..... DC 1-DCP 13

Note: Due to a continuous development policy it may be found that certain instruments differ slightly from the Component Layout Illustrations provided. These minor production changes will not, however, alter the basic circuit functions as the general performance of the Hi-Gain Preamplifier.

AMENDMENT SHEET No. 783/2

Operating and Maintenance Handbook

for

20-Mc/s SWEEP GENERATOR

TYPES TF 1099 and TF 1099/1

In our later models, the following changes have been made that are not shown in the main Circuit Diagram, Drawing No. XD 33215, or in the Spares Ordering Schedule :-

1) Two 100-ohm 1.5 watt resistors are included, one in each lead from the h.t. winding on the main transformer to the rectifier anodes.

2) The resistor R105 in the h.t. smoothing circuit has been reduced in value from 220 to 100 ohms.

The main Circuit Diagram should also show a 1-kΩ resistor, R146, connected between the slider of RV12 and pin 1 of V23.

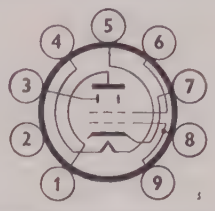
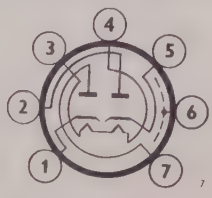
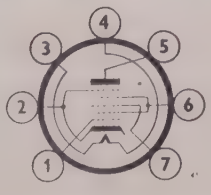
Valve Replacement Data

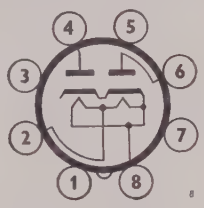
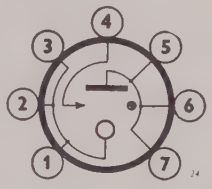
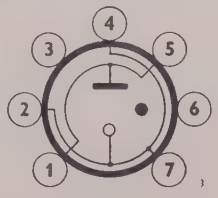
for

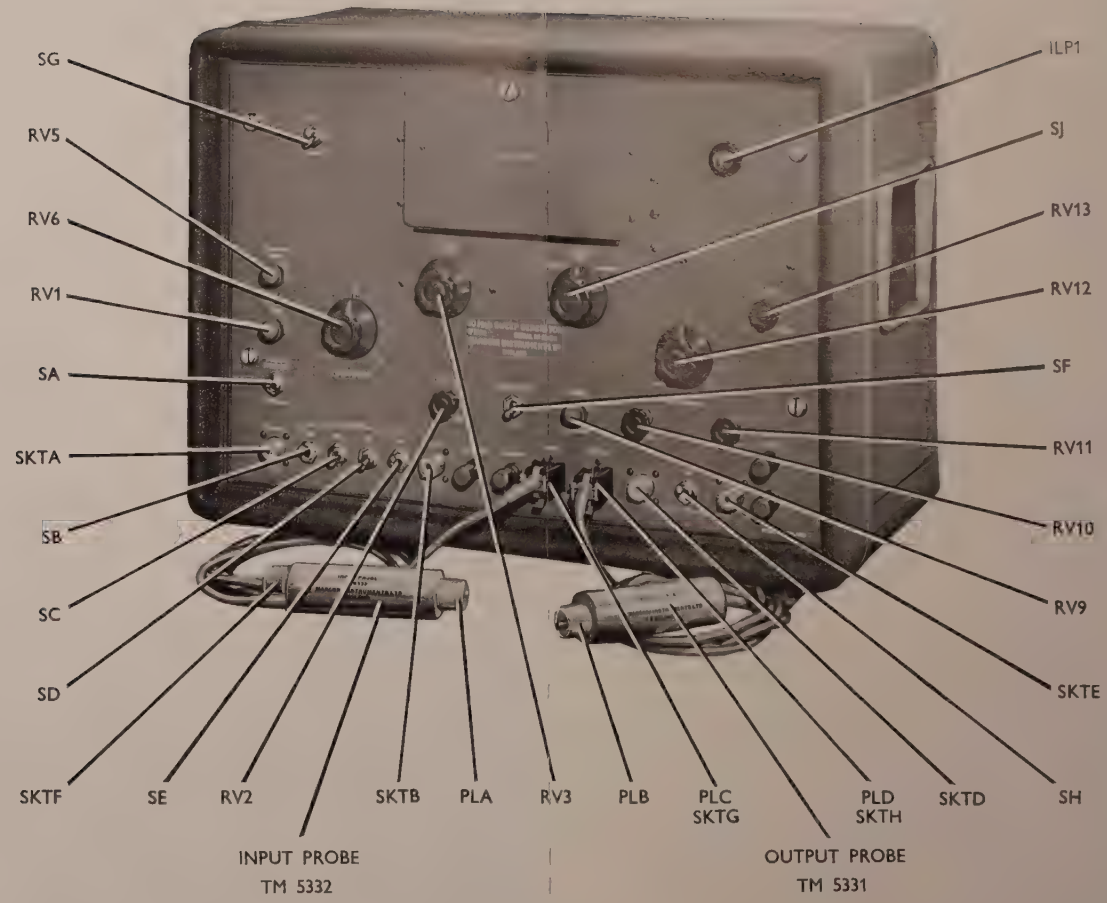
20 Mc/s SWEEP GENERATOR TYPES TF 1099 AND TF 1099/1

Any valve which becomes faulty should preferably be replaced by a valve of the type originally supplied in the instrument and designated in the following table. If this is not possible, the additional data given by the table may be used as a guide to suitable alternatives.

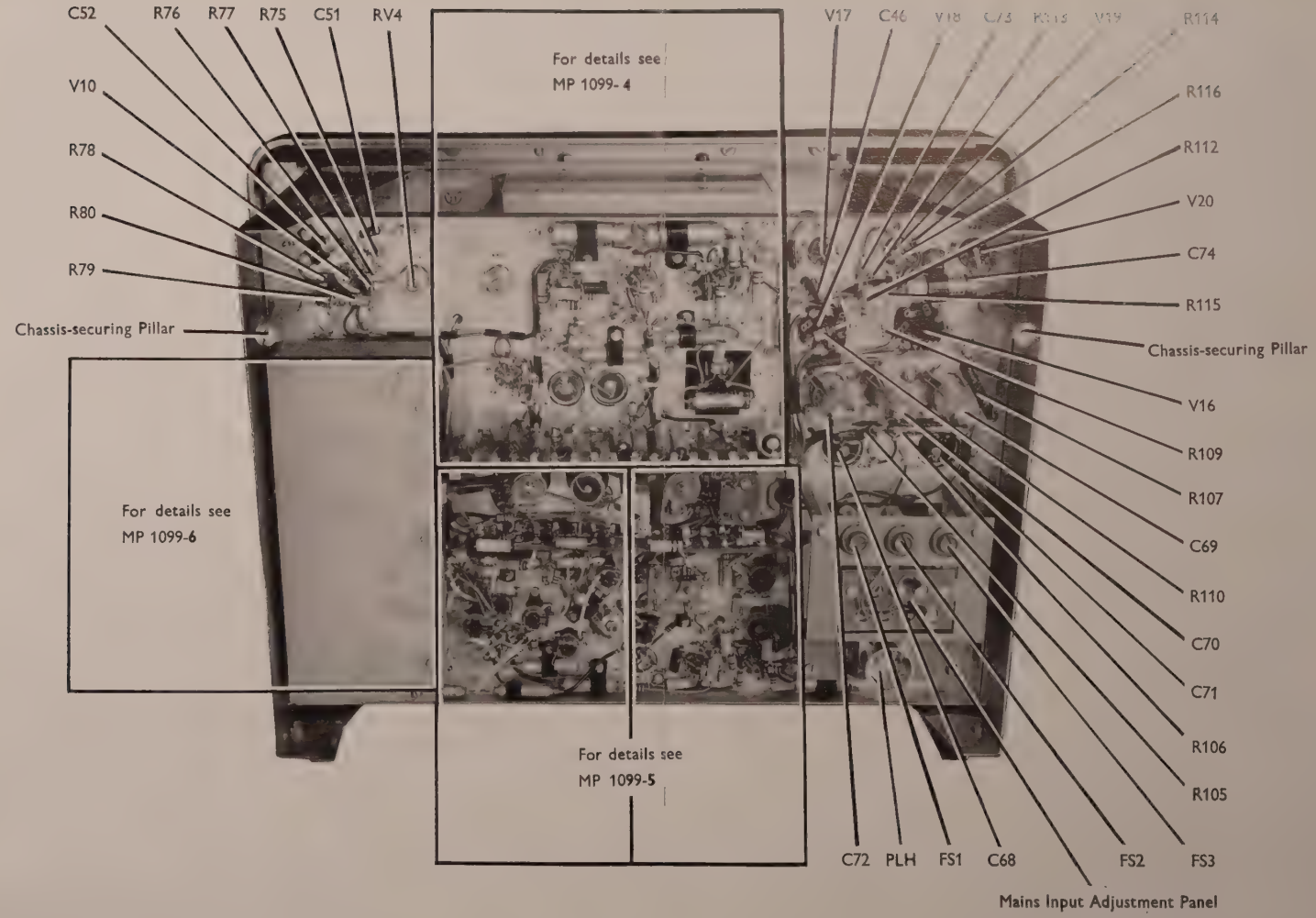
Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V1, V3, V5, V13, V23, V24 PENTODE BRIMAR 6BH6		CV3908	MINIATURE 7-PIN (B7G) 	6BH6
V2 TRIODE BRIMAR 6C4	EC90 L77	CV133	MINIATURE 7-PIN (B7G) 	6C4
V4 PENTODE BRIMAR 6BJ6		CV3909	MINIATURE 7-PIN (B7G) 	6BJ6
V6, V7, V8, V19 PENTODE BRIMAR 6AK5	EF95	CV850	MINIATURE 7-PIN (B7G) 	6AK5

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V9 TETRODE BRIMAR 5763	QV03–12	CV2129	MINIATURE 9-PIN (B9A) 	5763
V10 DOUBLE TRIODE BRIMAR 12AU7	ECC82	CV491	MINIATURE 9-PIN (B9A) 	12AU7
V11 DOUBLE TRIODE BRIMAR 12AT7	ECC81	CV455	MINIATURE 9-PIN (B9A) 	12AT7
V12, V14, V21, V22, V25 DOUBLE DIODE BRIMAR 6AL5	6D2 D77 D152 DD6 EB91	CV140	MINIATURE 7-PIN (B7G) 	6AL5
V15 HEPTODE BRIMAR 6BE6	X727 X77 EK90	CV453	MINIATURE 7-PIN (B7G) 	6BE6

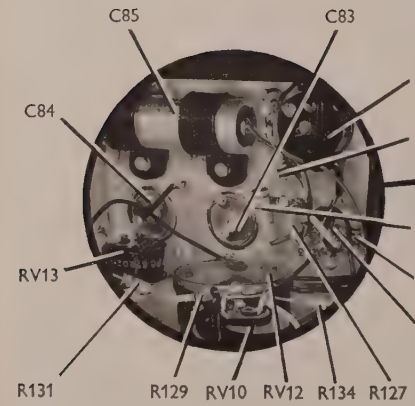
Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V16 FULL-WAVE RECTIFIER BRIMAR 5V4G		CV729	INTERNATIONAL OCTAL 	5V4G
V17 VOLTAGE STABILIZER BRIMAR OA2	150C2 QS150/15	CV1832	MINIATURE 7-PIN (B7G) 	OA2
V18 TETRODE BRIMAR 6CD6G			INTERNATIONAL OCTAL 	6CD6G
V20 VOLTAGE STABILIZER MULLARD 5651	85A2 QS83/3 QS1209	CV2573	MINIATURE 7-PIN (B7G) 	5651


SG
RV5
RV6
RV1
SA
SKTA
SB
SC
SD
SKTF
SE
RV2
SKTB
PLA
RV3
PLB
PLC
SKTG
PLD
SKTH
SKTD
SH
SKTE
RV9
RV10
RV11
SF
RV12
RV13
SJ
ILP1
INPUT PROBE
TM 5332
OUTPUT PROBE
TM 5331

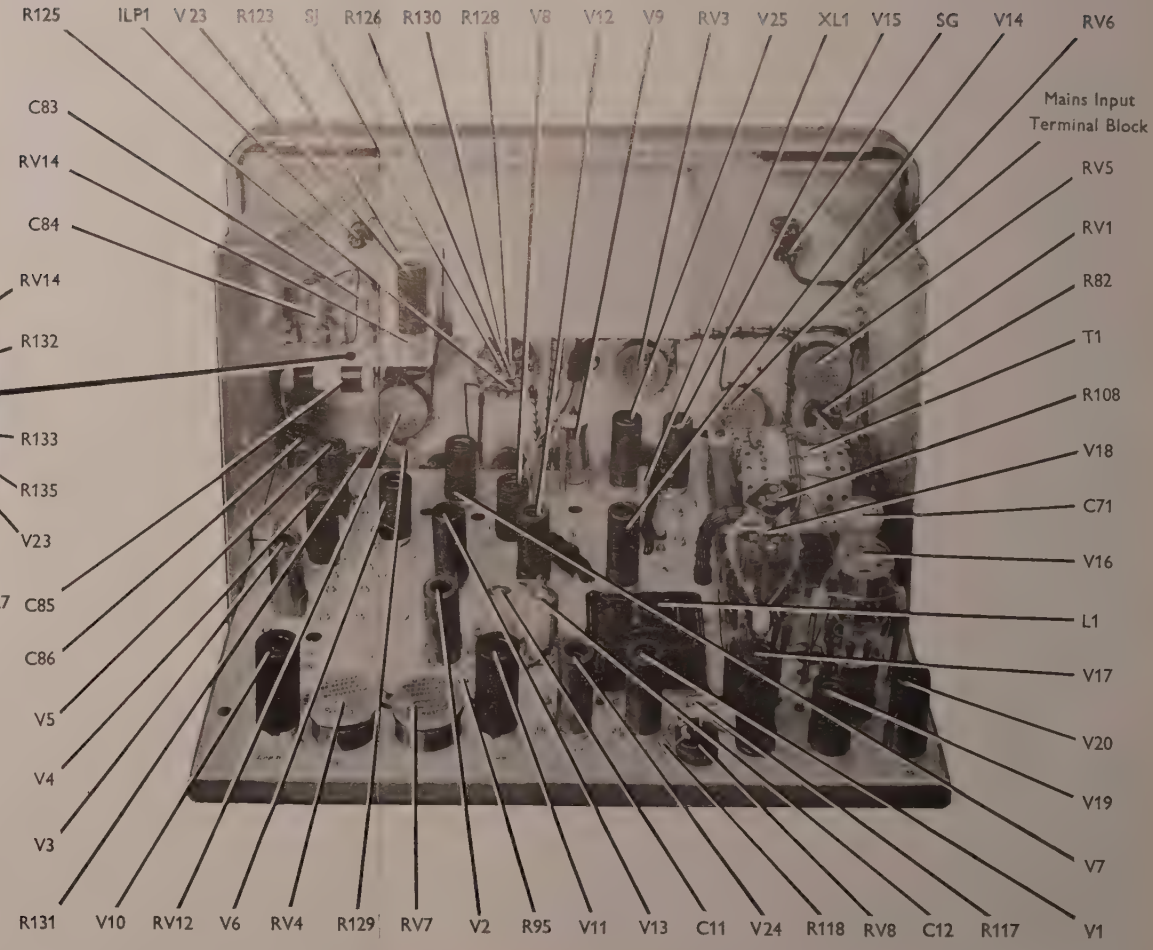
FRONT VIEW



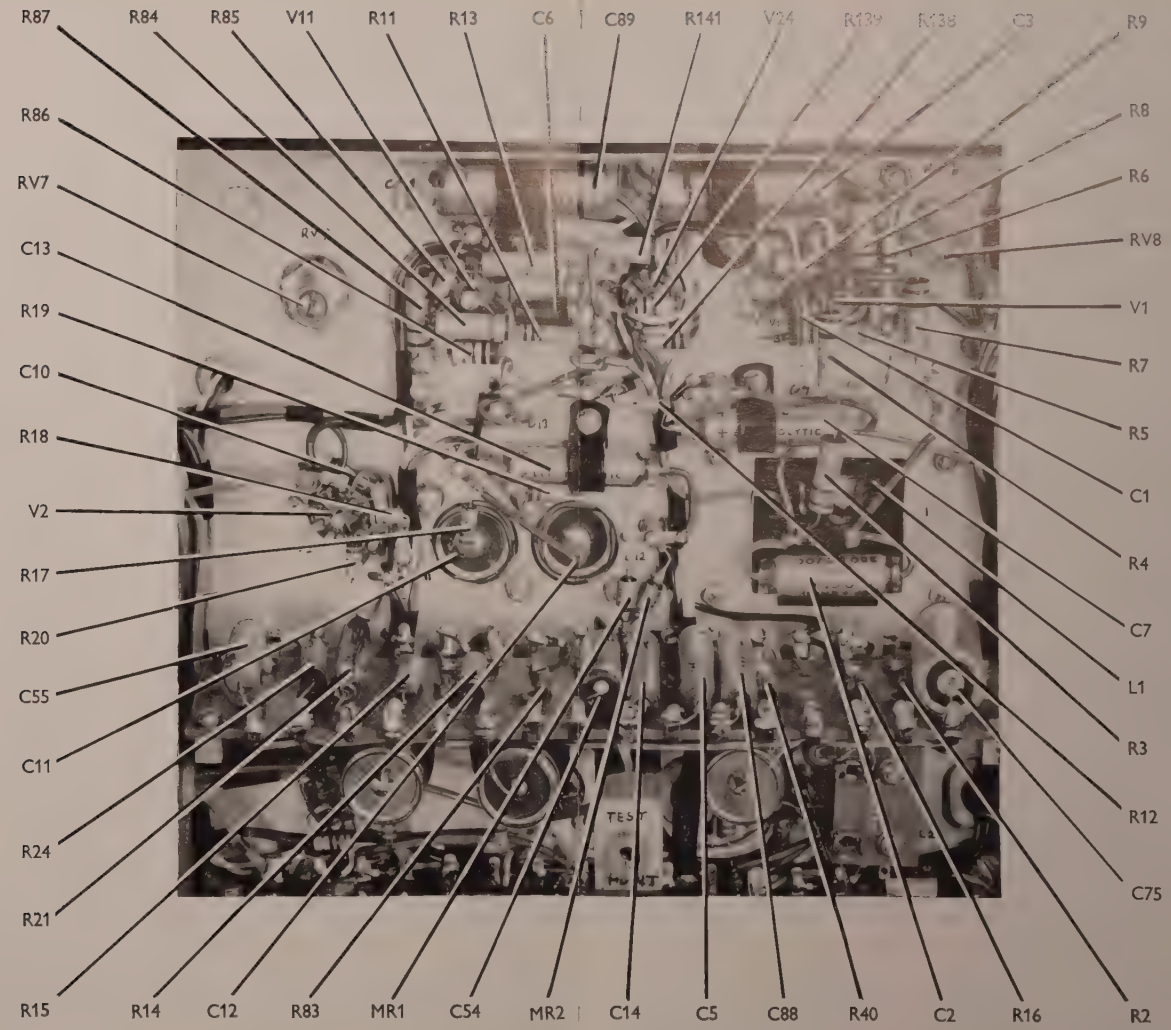
REAR VIEW
CHASSIS CLOSED UP



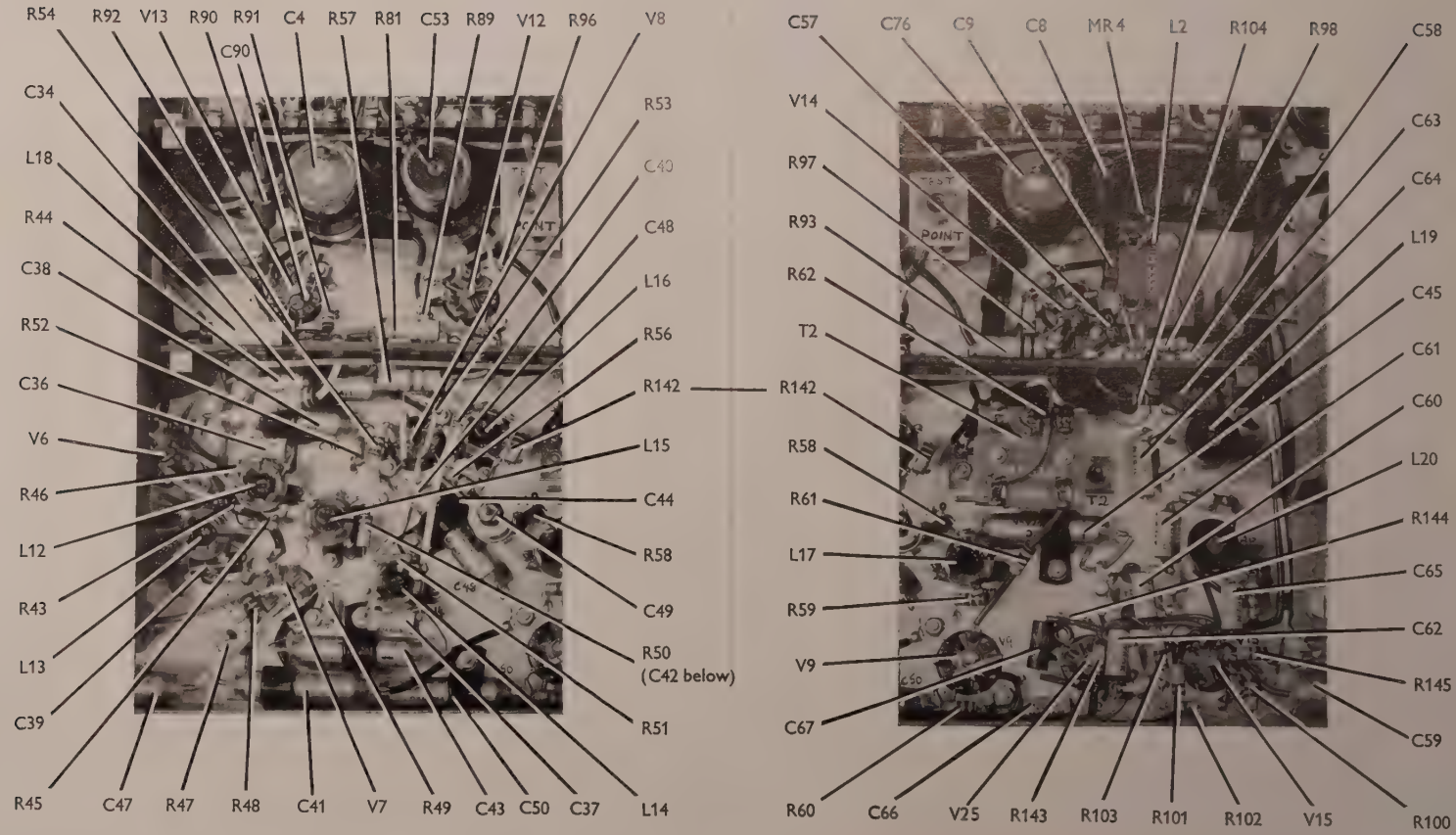
Underside View of Mixer



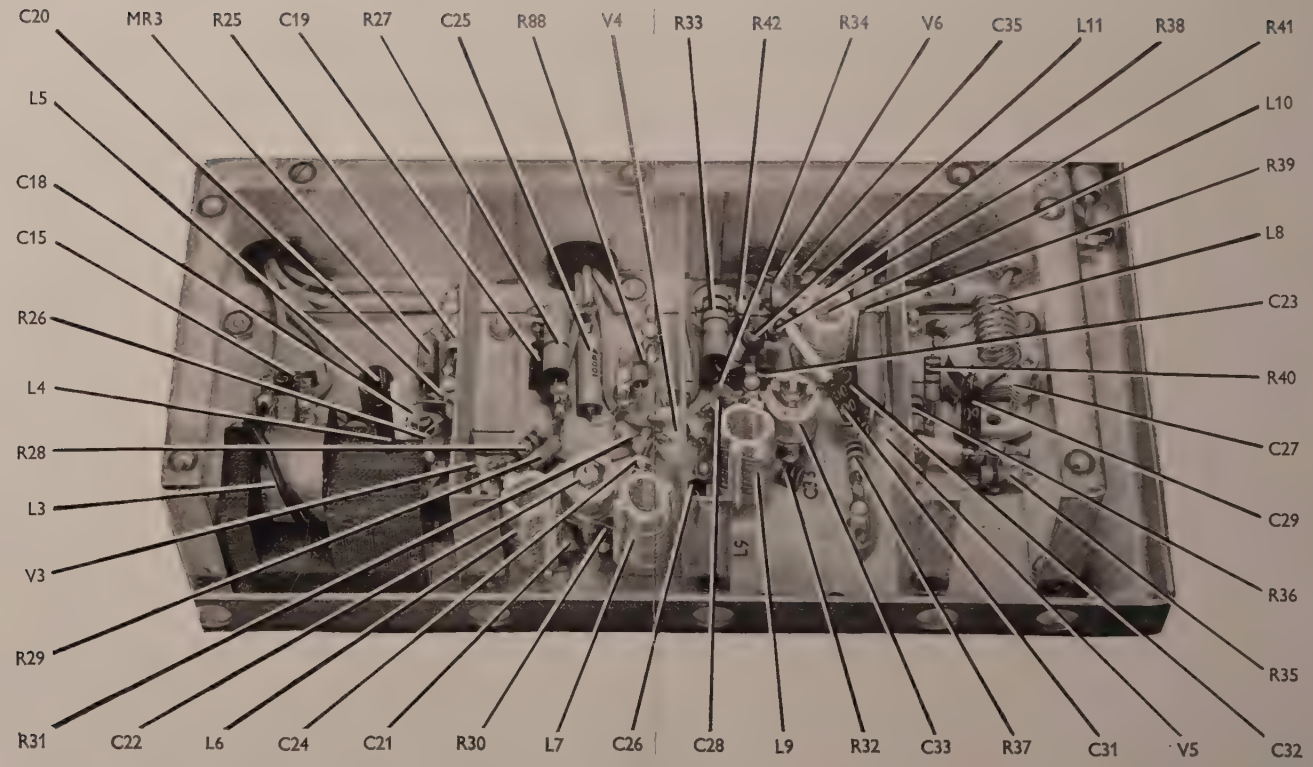
REAR VIEW
CHASSIS HINGED DOWN



MAIN CHASSIS
UPPER SECTION



MAIN CHASSIS
LOWER SECTION



MAIN CHASSIS
R.F. SECTION

SPARES ORDERING SCHEDULE No. SOS/1099

WITH CIRCUIT REFERENCES

for

20 Mc/s SWEEP GENERATOR TYPES TF 1099 and TF 1099/1

Applicable to Instruments

Serial Nos :-

519501 to 519525
JA 140/01 to JA 783/50
JA 981/001 to JA 981/100

When ordering replacement parts, ALWAYS QUOTE THE TYPE NUMBER AND SERIAL NUMBER OF THE INSTRUMENT CONCERNED.

To specify the individual parts required, STATE FOR EACH PART THE QUANTITY REQUIRED AND THE APPROPRIATE SOS ITEM NUMBER.

For example, to order replacements for the 1-megohm resistor, R1, and the 0.01-μF capacitor, C1, quote as follows :-

Spares Required for TF 1099 (or TF 1099/1), Serial Number 000000

1 off, SOS Item 1.
1 off, SOS Item 158.

It is important that the distinguishing code "SOS" preceding each item number should not be omitted.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS	
1a	R1	Composition, 1 megohm, 10%, $\frac{1}{4}$W.	108-TF1099
2a	R2	Composition, 470 kilohms, 10%, $\frac{1}{4}$W.	5-TM5335

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
3a	R3	Composition, 22 kilohms, 10%, ½W.	109-TF1099
4a	R4	Composition, 10 kilohms, 10%, ½W.	110-TF1099
5a	R5	Composition, 68 kilohms, 10%, ¼W.	111-TF1099
6a	R6	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
7a	R7	Composition, 100 kilohms, 10%, ½W.	113-TF1099
8a	R8	Composition, 100 kilohms, 10%, ½W.	113-TF1099
9	R9	Composition, 2.7 megohms*, 10%, ¼W.	114-TF1099
10a	R10	Composition, 2.2 megohms, 10%, ¼W.	115-TF1099
11a	R11	Composition, 1 megohm, 10%, ¼W.	108-TF1099
12a	R12	Composition, 15 kilohms, 10%, ¼W.	116-TF1099
13a	R13	Composition, 390 kilohms, 10%, ½W.	154-TF1099
14a	R14	Composition, 100 kilohms, 10%, ½W.	6-TM5335
15a	R15	Composition, 560 kilohms, 10%, ½W.	7-TM5335
16a	R16	Composition, 1 megohm, 10%, ¼W.	8-TM5335
17a	R17	Composition, 2.2 kilohms, 10%, ¼W.	118-TF1099
18a	R18	Composition, 1.5 kilohms, 10%, ¼W.	119-TF1099
19a	R19	Composition, 150 kilohms, 10%, ¼W.	120-TF1099
20a	R20	Composition, 1.5 kilohms, 10%, ¼W.	119-TF1099
21	R21	Wire-Wound, 22 kilohms, 5%, 6W.	9-TM5335

* Nominal Value; actual value determined during calibration procedure.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
22a	R22	Composition, 220 ohms, 10%, ¼W.	121-TF1099
23a	R23	Composition, 220 ohms, 10%, ¼W.	121-TF1099
24a	R24	Composition, 1 kilohm, 10%, ½W.	10-TM5335
25a	R25	Composition 47 kilohms, 10%, ¼W.	122-TF1099
26a	R26	Composition, 22 ohms, 10%, ¼W.	123-TF1099
27a	R27	Composition, 3.3 kilohms, 10%, ½W.	124-TF1099
28a	R28	Composition, 470 ohms, 10%, ¼W.	125-TF1099
29a	R29	Composition, 33 kilohms, 10%, ¼W.	126-TF1099
30a	R30	Composition, 470 ohms, 10%, ¼W.	125-TF1099
31a	R31	Composition, 47 kilohms, 10%, ¼W.	122-TF1099
32a	R32	Composition 1 kilohm, 10%, ¼W.	127-TF1099
33a	R33	Composition, 1 kilohm, 10%, ½W.	128-TF1099
34a	R34	Composition, 560 ohms, 10%, ½W.	129-TF1099
35a	R35	Composition, 47 kilohms, 10%, ¼W.	122-TF1099
36a	R36	Composition, 100 ohms, 10%, ¼W.	130-TF 1099
37a	R37	Composition, 1 kilohm, 10%, ¼W.	127-TF 1099
38a	R38	Composition, 3.3 kilohms, 10%, ½W.	124-TF 1099
39a	R39	Composition, 3.3 kilohms, 10%, ½W.	124-TF 1099
40a	R40	Composition, 100 ohms, 10%, ¼W.	130-TF 1099
41a	R41	Composition, 560 ohms, 10%, ¼W.	129-TF 1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
42a	R42	Composition, 220 kilohms, 10%, ¼W.	132-TF1099
43a	R43	Composition, 560 ohms, 10%, ¼W.	129-TF1099
44	R44	Composition, 15 kilohms, 10%, 1W.	173-TF1099
45a	R45	Composition, 3.3 kilohms, 10%, ¼W.	134-TF1099
46a	R46	Composition, 1.5 kilohms, 10%, ¼W.	119-TF1099
47a	R47	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
48a	R48	Composition, 100 ohms, 10%, ¼W.	130-TF1099
49a	R49	Composition, 220 ohms, 10%, ¼W.	121-TF1099
50a	R50	Composition 1.2 kilohms, 10%, ¼W.	135-TF1099
51a	R51	Composition, 3.3 kilohms, 10%, ¼W.	134-TF1099
52a	R52	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
53a	R53	Composition, 4.7 kilohms, 10%, ¼W.	136-TF1099
54a	R54	Composition, 100 ohms, 10%, ¼W.	130-TF1099
55a	R55	Composition, 220 ohms, 10%, ¼W.	121-TF1099
56a	R56	Composition, 680 ohms, 10%, ¼W.	137-TF1099
57	R57	Composition, 4.7 kilohms, 10%, 1W.	138-TF1099
58a	R58	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
59	R59	Composition, 100 ohms, 10%, ½W.	133-TF1099
60	R60	Composition, 150 ohms, 10%, ½W.	139-TF1099
61	R61	Composition, 100 ohms, 10%, ½W.	133-TF1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
63	R63	Composition, 75 ohms, 2%, ¼W.	10-TM5336
63	R63	Carbon, High Stability, 650 ohms, 1%, ¼W.	141-TF1099
64	R64	Carbon, High Stability, 17.5 ohms, 1%, ¼W.	142-TF1099
65	R65	Carbon, High Stability, 650 ohms, 1%, ¼W.	141-TF1099
66	R66	Carbon, High Stability, 330 ohms, 1% ¼W.	143-TF1099
67	R67	Carbon, High Stability, 36 ohms, 1%, ¼W.	144-TF1099
68	R68	Carbon, High Stability, 330 ohms, 1%, ¼W.	143-TF1099
69	R69	Carbon, High Stability, 220 ohms, 1%, ¼W.	145-TF1099
70	R70	Carbon, High Stability, 56 ohms, 1%, ¼W.	146-TF1099
71	R71	Carbon, High Stability, 220 ohms, 1%, ¼W.	145-TF1099
72	R72	Carbon, High Stability, 174 ohms, 1%, ¼W.	147-TF1099
73	R73	Carbon, High Stability, 79 ohms, 1%, ¼W.	148-TF1099
74	R74	Carbon, High Stability, 174 ohms, 1%, ¼W.	147-TF1099
75a	R75	Composition, 68 kilohms, 10%, ½W.	111-TF1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
76a	R76	Composition, 100 ohms, 10%, ¼W.	130-TF1099
77a	R77	Composition, 390 kilohms, 10%, ½W.	117-TF1099
78a	R78	Composition, 10 kilohms, 10%, ½W.	110-TF1099
79a	R79	Composition, 560 kilohms, 10%, ¼W.	149-TF1099
80a	R80	Composition, 2.2 kilohms, 10%, ½W.	150-TF1099
81a	R81	Composition, 270 kilohms, 10%, ½W.	6-TM5336
82a	R82	Composition, 22 kilohms, 10%, ¼W.	152-TF1099
83a	R83	Composition, 2.7 megohms, 10%, ¼W.	11-TM5335
84a	R84	Composition, 180 kilohms, 10%, ½W.	153-TF1099
85a	R85	Composition, 82 kilohms, 10%, ½W.	156-TF1099
86a	R86	Composition, 100 ohms, 10%, ½W.	130-TF1099
87a	R87	Composition, 10 kilohms, 10%, ½W.	110-TF1099
88a	R88	Composition, 330 ohms, 10%, ½W.	157-TF1099
89a	R89	Composition, 4.7 kilohms, 10%, ¼W.	136-TF1099
90a	R90	Composition, 220 kilohms, 10%, ½W.	155-TF1099
91a	R91	Composition, 1.5 kilohms, 10%, ¼W.	119-TF1099
92a	R92	Composition, 220 ohms, 10%, ¼W.	121-TF1099
93	R93	Composition, 100 kilohms, 10%, 1W.	7-TM5336
94a	R94	Composition, 680 kilohms, 10%, ¼W.	11-TM5336
95a	R95	Composition, 470 ohms, 10%, ¼W.	125-TF1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
96a	R96	Composition, 68 kilohms, 10%, ¼W.	111-TF1099
97a	R97	Composition, 680 kilohms, 10%, ¼W.	158-TF1099
98a	R98	Composition, 470 ohms, 10%, ¼W.	8-TM5336
99a	R99	Composition, 270 ohms, 10%, ¼W.	9-TM5336
100a	R100	Composition, 100 ohms, 10%, ¼W.	130-TF1099
101a	R101	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
102a	R102	Composition, 47 ohms, 10%, ¼W.	159-TF1099
103a	R103	Composition, 560 ohms, 10%, ¼W.	129-TF1099
104a	R104	Composition, 39 kilohms, 10%, ¼W.	160-TF1099
105a	R105	Wire-Wound, 100 ohms, 5%, 3W.	161-TF1099
106	R106	Wire-Wound, 4.7 kilohms, 5%, 6W.	162-TF1099
107	R107	Wire-Wound, 2.2 kilohms, 5%, 6W.	163-TF1099
108a	R108	Composition, 22 ohms, 10%, ¼W.	123-TF1099
109a	R109	Composition, 1.2 kilohms, 10%, ¼W.	135-TF1099
110a	R110	Composition, 100 ohms, 10%, ¼W.	130-TF1099
111a	R111	Composition, 100 ohms, 10%, ¼W.	130-TF1099
112a	R112	Composition, 150 kilohms, 10%, ½W.	164-TF1099
113a	R113	Composition, 100 kilohms, 10%, ¼W.	112-TF1099
114a	R114	Composition, 10 kilohms, 10%, ¼W.	165-TF1099
115a	R115	Composition, 47 kilohms, 10%, ½W.	166-TF1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
116a	R116	Composition, 10 kilohms, 10%, $\frac{1}{4}$W.	165-TF1099
117a	R117	Composition, 150 kilohms, 10%, $\frac{1}{2}$W.	164-TF1099
118a	R118	Composition, 68 kilohms, 10%, $\frac{1}{4}$W.	111-TF1099
119	R119	Carbon, High Stability, 1.3 kilohms, 1%, $\frac{1}{4}$W.	167-TF1099
120a	R120	Carbon, High Stability, 8.65 ohms, 5%, $\frac{1}{4}$W.	171-TF1099
121	R121	Carbon, High Stability, 1.3 kilohms, 1%, $\frac{1}{4}$W.	167-TF1099
122	R122	Composition, 75 ohms, 2%, $\frac{1}{4}$W.	3-TM5331
123a	R123	Composition, 10 ohms, 10%, $\frac{1}{4}$W.	151-TF1099
124a	R125	Composition, 4.7 kilohms, 10%, $\frac{1}{4}$W.	136-TF1099
125a	R126	Composition, 4.7 kilohms, 10%, $\frac{1}{4}$W.	136-TF1099
126a	R127	Composition, 220 kilohms, 10%, $\frac{1}{2}$W.	132-TF1099
127a	R128	Composition, 220 kilohms, 10%, $\frac{1}{4}$W.	132-TF1099
128a	R129	Composition, 100 kilohms, 10%, $\frac{1}{4}$W.	112-TF1099
129a	R130	Composition, 120 kilohms, 10%, $\frac{1}{4}$W.	168-TF1099
130a	R131	Composition, 22 kilohms, 10%, $\frac{1}{4}$W.	152-TF1099
131a	R132	Composition, 1 kilohm, 10%, $\frac{1}{4}$W.	127-TF1099
132	R133	Composition, 22 kilohms, 10%, 1W.	174-TF1099
133a	R134	Composition, 33 kilohms, 10%, $\frac{1}{2}$W.	126-TF1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
134a	R135	Composition, 220 ohms, 10%, 1/4W.	121-TF1099
135a	R136	Composition, 470 kilohms, 10%, 1/4W.	169-TF1099
136a	R137	Composition, 100 ohms, 10%, 1/4W.	130-TF1099
137a	R138	Composition, 1 kilohm, 10%, 1/4W.	127-TF1099
138a	R139	Composotion, 1 kilohm, 10%, 1/4W.	127-TF1099
139a	R140	Composition, 10 kilohms, 10%, 1/4W.	12-TM5335
140a	R141	Composition, 15 kilohms, 10%, $\frac{1}{2}$W.	170-TF1099
141a	R142	Composition, 1 kilohm, 10%, 1/4W.	127-TF1099
142a	R143	Composition, 680 kilohms, 10%, 1/4W.	158-TF1099
143a	R144	Composition, 680 kilohms, 10%, 1/4W.	158-TF1099
143/1a	R145	Composition, 100 ohms, 10%, 1/4W.	130-TF1099
143/2	R146	Composition, 1 kilohm, 10%, 1/4W.	172-TF1099
143/3	R147	Wire-wound, 100 ohms, 5%, 3W.	175-TF1099
143/4	R148	Wire-wound, 100 ohms, 5%, 3W.	175-TF1099
		VARIABLE RESISTORS	
144	RV1	Composition, 1 megohm, 10%, 1/4W.	PC67202/37
145	RV2	Composition, 1 megohm, 10%, 3/4W.	PC67203/38
146	RV3	Wire-wound, 100 kilohms, 10%, 1W.	PC67402/54
147	RV4	Wire-wound, 25 kilohms, 10%, 1W.	PC67402/45
148	RV5	Wire-wound, 25 kilohms, 10%, 1W.	PC67402/45
149	RV6	Wire-wound, 5 kilohms, 10%, 1W.	PC67402/38
150	RV7	Wire-wound, 500 ohms, 10% 1W.	PC67402/25

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VARIABLE RESISTORS (continued)	
151	RV8	Composition, 50 kΩ ±10%, 1/4W.	PC67202/21
152	RV9	Composition, 500 kΩ ±10%, 1/4W.	PC67202/33
153	RV10	Composition, 50 kΩ ±10%, 1/4W.	PC67202/22
154	RV11	Composition, 100 kΩ ±10%, 1/4W.	PC67202/26
155	RV12	Wire-Wound, 100 kΩ ±10%, 1W.	PC67402/54
156	RV13	Composition, 100 kΩ ±10%, 1/4W.	PC67202/26
157	RV14	Composition, 5 kΩ ±10%, 1/4W.	PC67202/9
		CAPACITORS	
158	C1	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
159	C2	Paper, 0.05 µF ±20%, 350 V d.c.	PC19202/13
160	C3	Paper, 0.1 µF ±20%, 350 V d.c.	PC19202/15
161	C4	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2
162	C5	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
163	C6	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
164	C7	Electrolytic, 20 µF +50% -20%, 12 V d.c.	PC18404/6
165	C8	Electrolytic, 2 µF +50% -20%, 150 V d.c.	PC18404/2
166	C9	Mica, 0.002 µF ±5%, 350 V d.c.	214-TF 1099
167	C10	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
168	C11	Electrolytic, 50 µF +50% -20%, 15 V d.c.	213-TF 1099
169	C12	Electrolytic, 50 µF +50% -20%, 15 V d.c.	213-TF 1099
170	C13	Electrolytic, 5 µF, +50% -20%, 50 V d.c.	PC18404/4
171	C14	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
172	C15	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
173	C16	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
174	C17	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
175	C18	Ceramic, 100 µµF ±10%, 500 V d.c.	PC18202/13
176	C19	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
177	C20	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
178	C21	Ceramic, 100 µµF ±10%, 500 V d.c.	PC18202/13
179	C22	Air, Preset, 3 to 30 µµF.	PC20001/4
180	C23	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
181	C24	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
182	C25	Ceramic, 100 µµF ±10%, 500 V d.c.	PC18202/13
183	C26	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
184	C27	Air, Preset, 3.3 to 25 µµF.	PC20002/5
185	C28	Ceramic, 100 µµF ±10%, 500 V d.c.	PC18202/13
186	C29	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
187	C30	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099

SCS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
188	C31	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
189	C32	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
190	C33	Air, Preset, 3 to 30 µµF.	PC20001/4
191	C34	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
192	C35	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
193	C36	Ceramic, 4.7 µµF ±10%, 500 V d.c.	PC18201/5
194	C37	Ceramic, 4.7 µµF ±10%, 500 V d.c.	PC18201/5
195	C38	Electrolytic, 20 µF +50% -20%, 12 V d.c.	PC18404/6
196	C39	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
197	C40	Ceramic, 10 µµF ±10%, 500 V d.c.	PC18201/9
198	C41	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
199	C42	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
200	C43	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
201	C44	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
202	C45	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
203	C46	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
204	C47	Electrolytic, 20 µF +50% -20%, 12 V d.c.	PC18404/6
205	C48	Electrolytic, 20 µF +50% -20%, 12 V d.c.	PC18404/6
206	C49	Air, Preset, 2 to 8 µµF.	PC20001/3
207	C50	Electrolytic, 20 µF +50% -20%, 12 V d.c.	PC18404/6

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
208	C51	Paper, 500 µµF ±20%, 600 V d.c.	203-TF 1099
209	C52	Paper, 0.02 µF ±20%, 350 V d.c.	PC19202/11
210	C53	Paper, 0.25 µF ±20%, 350 V d.c.	PC19202/17
211	C54	Paper, 0.05 µF ±20%, 350 V d.c.	PC19202/13
212	C55	Paper, 0.02 µF ±20%, 350 V d.c.	PC19202/11
213	C56	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
214	C57	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
215	C58	Ceramic, 33 µµF ±10%, 500 V d.c.	PC18202/7
216	C59	Paper, 0.1 µF ±20%, 350 V d.c.	PC19202/15
217	C60	Ceramic, 10 µµF ±10%, 500 V d.c.	PC18201/9
218	C61	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
219	C62	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
220	C63	Mica, 150 µµF ±5%, 750 V d.c.	PC18802/15
221	C64	Ceramic, 82 µµF ±10%, 500 V d.c.	PC18202/12
222	C65	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
223	C66	Ceramic, 47 µµF ±10%, 500 V d.c.	PC18202/9
224	C67	Paper, 0.01 µF ±20%, 400 V d.c.	188-TF 1099
225	C68	Electrolytic, 32 µF +50% -20%, 450 Vd.c.	PC18407/1
226	C69	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2
227	C70	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
228	C71	Electrolytic, 32 µF +50% -20%, 450 V d.c.	PC18407/1
229	C72	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2
230	C73	Paper, 0.002 µF ±20%, 400 V d.c.	PC19308/4
231	C74	Paper, 0.1 µF ±20%, 350 V d.c.	PC19202/15
232	C75	Paper, 1 µF ±25%, 150 V d.c.	PC19301/4
233	C76	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2
234	C77	Paper, 0.001 µF ±20%, 600 V d.c.	1-TM 5332
235	C78	Paper, 0.001 µF ±20%, 600 V d.c.	1-TM 5332
236	C79	Paper, 0.001 µF +20%, 600 V d.c.	1-TM 5331
237	C80	Paper, 0.001 µF ±20%, 600 V d.c.	1-TM 5331
238	C81	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
239	C82	Paper, 0.001 µF ±20%, 600 V d.c.	193-TF 1099
240	C83	Electrolytic, 8 µF +50% -20%, 450 V d.c.	PC18406/2
241	C84	Electrolytic, 8 µF +50% - 20%, 450 V d.c.	PC18406/2
242	C85	Paper, 2 µF ±25%, 250 V d.c.	PC19302/6
243	C86	Paper, 1 µF ±25%, 150 V d.c.	PC19301/4
244	C87	Electrolytic, 50 µF +100% -20%, 25 V d.c.	PC18406/16
245	C88	Electrolytic, 1 µF +50% -20%, 275 V d.c.	PC18404/1
246	C89	Paper, 0.1 µF ±20%, 350 V d.c.	PC19202/15
+ 246/1	C90	Paper, 0.1 µF ±20%, 600 V d.c.	193 - TF1099

SCS Item No.	Circuit Ref.	Description	Works Ref.
		TRANSFORMERS AND INDUCTORS	
247	T1	Mains Transformer.	TM5151/4
248	T2	Video Sweep Output Transformer.	TM5333/1
249	L1	Time Base Anode Load Inductor.	TM4159/2
250	L2	A.F.C. Tuned Circuit Inductor.	TM5333
251	L3) L4)	Ferrite Modulator Inductor Assembly.	TM5334
252	L5	Swept Oscillator Tuned Circuit Inductor.	TM4639/2
253	L6	Band-Pass Filter Inductor.	TM3002/6
254	L7	Band-Pass Filter Inductor.	TM3002/7
255	L8	Fixed Oscillator Tuned Circuit Inductor.	TB22722/24
256	L9	Band-Pass Filter Inductor.	TM3002/6
257	L10	Band-Pass Filter Inductor.	TM3002/7
258	L11	Mixer Grid Compensating Inductor.	TB23173/29
259	L12	Mixer Amplifier Compensating Inductor.	TM4639/3
260	L13	Mixer Amplifier Compensating Inductor.	TM4639/4
261	L14	Video Amplifier Compensating Inductor.	TM4639/3
262	L15	Video Amplifier Compensating Inductor.	TM4639/4
263	L16	Video Amplifier Compensating Inductor.	TM4639/3
264	L17	Video Amplifier Compensating Inductor.	TM4639/4
265	L18	R.F. Inductor.	TB16363/11
266	L19	1-Mc/s Marker Tuned Circuit Inductor.	TB26148
267	L20	2-Mc/s Marker Tuned Circuit Inductor.	TB 26148/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS	
268	V1	6BH6, Pentode.	237-TF1099
269		Holder for V1, B7G with skirt.	70-TF1099
270		Screening Can for V1.	PC17501/2
271	V2	6C4, Triode.	238-TF1099
272		Holder for V2, B7G with skirt.	70-TF1099
273		Screening Can for V2.	PC17501/2
274	V3	6BH6, Pentode.	237-TF1099
275		Holder for V3, B7G with skirt.	PC81823/1
276		Screening Can for V3.	PC17501/2
277	V4	6BJ6, Pentode.	239-TF1099
278		Holder for V4, B7G with skirt.	PC81823/1
279		Screening Can for V4.	PC17501/2
280	V5	6BH6, Pentode.	237-TF1099
281		Holder for V5, B7G with skirt.	PC81823/1
282		Screening Can for V5.	PC17501/2
283	V6	6AK5, Pentode.	240-TF1099
284		Holder for V6, B7G with skirt.	PC81823/1
285		Screening Can for V6.	PC17501/1
286	V7	6AK5, Pentode.	240-TF1099
287		Holder for V7, B7G with skirt.	70-TF1099
288		Screening Can for V7.	PC17501/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS (continued)	
289	V8	6AK5, Pentode.	240-TF1099
290		Holder for V8, B7G with skirt.	70-TF1099
291		Screening Can for V8.	PC17501/1
292	V9	5763, Beam Tetrode.	241-TF1099
293		Holder for V9, B9A without skirt.	72-TF1099
294		Retainer for V9.	PC82501/2
295	V10	12AU7, Double Triode.	242-TF1099
296		Holder for V10, B9A with skirt.	71-TF1099
297		Screening Can for V10.	PC17502/2
298	V11	12AT7, Double Triode.	243-TF1099
299		Holder for V11, B9A with skirt.	71-TF1099
300		Screening Can for V11.	PC17502/2
301	V12	EB91, Double Diode.	244-TF1099
302		Holder for V12, B7G with skirt.	70-TF1099
303		Screening Can for V12.	PC17501/2
304	V13	6BH6, Pentode.	237-TF1099
305		Holder for V13, B7G with skirt.	70-TF1099
306		Screening Can for V13.	PC17501/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS AND RETAINERS (continued)	
307	V14	EB91, Double Diode.	244-TF1099
308		Holder for V14, B7G with skirt.	70-TF1099
309		Screening Can for V14.	PC17501/2
310	V15	6BE6, Heptode.	245-TF1099
311		Holder for V15, B7G with skirt.	70-TF1099
312		Screening Can for V15.	PC17501/2
313	V16	5V4G, Full-Wave Rectifier.	246-TF1099
314		Holder for V16, International Octal.	PC81814/1
315		Retainer for V16.	TC22744/12
316	V17	OA2, Voltage Stabilizer.	247-TF1099
317		Holder for V17, B7G with skirt.	70-TF1099
318		Screening Can for V17.	PC17501/2
319	V18	6CD6G, Beam Tetrode.	248-TF1099
320		Holder for V18, International Octal.	PC81814/1
321		Retainer for V18.	TC22744/198
322		Top Cap Connector for V18.	79-TF1099
323	V19	6AK5, Pentode.	240-TF1099
324		Holder for V19, B7G with skirt.	70-TF1099
325		Screening Can for V19.	PC17501/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS AND RETAINERS (continued)	
326	V20	5651, Voltage Stabilizer.	249-TF1099
327		Holder for V20, B7G with skirt.	70-TF1099
328		Screening Can for V20.	PC17501/2
329	V21	EB91, Double Diode.	244-TF1099
330		Holder for V21, B7G without skirt.	19-TM5332
331		Retainer for V21.	TC22744/63
332	V22	EB91, Double Diode.	244-TF1099
333		Holder for V22, B7G without skirt.	19-TM5331
334		Retainer for V22.	TC22744/63
335	V23	6BH6, Pentode.	237-TF1099
336		Holder for V23, B7G with skirt.	70-TF1099
337		Screening Can for V23.	PC17501/2
338	V24	6BH6, Pentode.	237-TF1099
339		Holder for V24, B7G with skirt.	70-TF1099
340		Screening Can for V24.	PC17501/2
341	V25	EB91, Double Diode.	244-TF1099
342		Holder for V25, B7G with skirt.	70-TF1099
343		Screening Can for V25.	PC17501/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		SEMICONDUCTORS	
344	MR1	CG4-E, Germanium Diode.	236-TF1099
345	MR2	CG4-E, Germanium Diode.	236-TF1099
346	MR3	CG4-E, Germanium Diode.	236-TF1099
347	MR4	OA202, Silicon Diode.	250-TF1099
		CRYSTAL AND HOLDER	
348	XL1	5-Mc/s Crystal, Type QO 1670A.	228-TF1099
349		2-pin Holder for XL1.	251-TF1099
		LAMP AND HOLDER	
350	ILP.1	6.3-volt, 0.15-amp, M.B.C. Pilot Lamp.	231-TF1099
351		Holder and Translucent Cover for ILP.1.	TB25460/10
		FUSES AND HOLDERS	
352	FS1	2-amp Cartridge Fuse.	234-TF1099
353		Holder for FS1.	TB24330/1
354	FS2	2-amp Cartridge Fuse.	234-TF1099
355		Holder for FS2.	TB24330/1

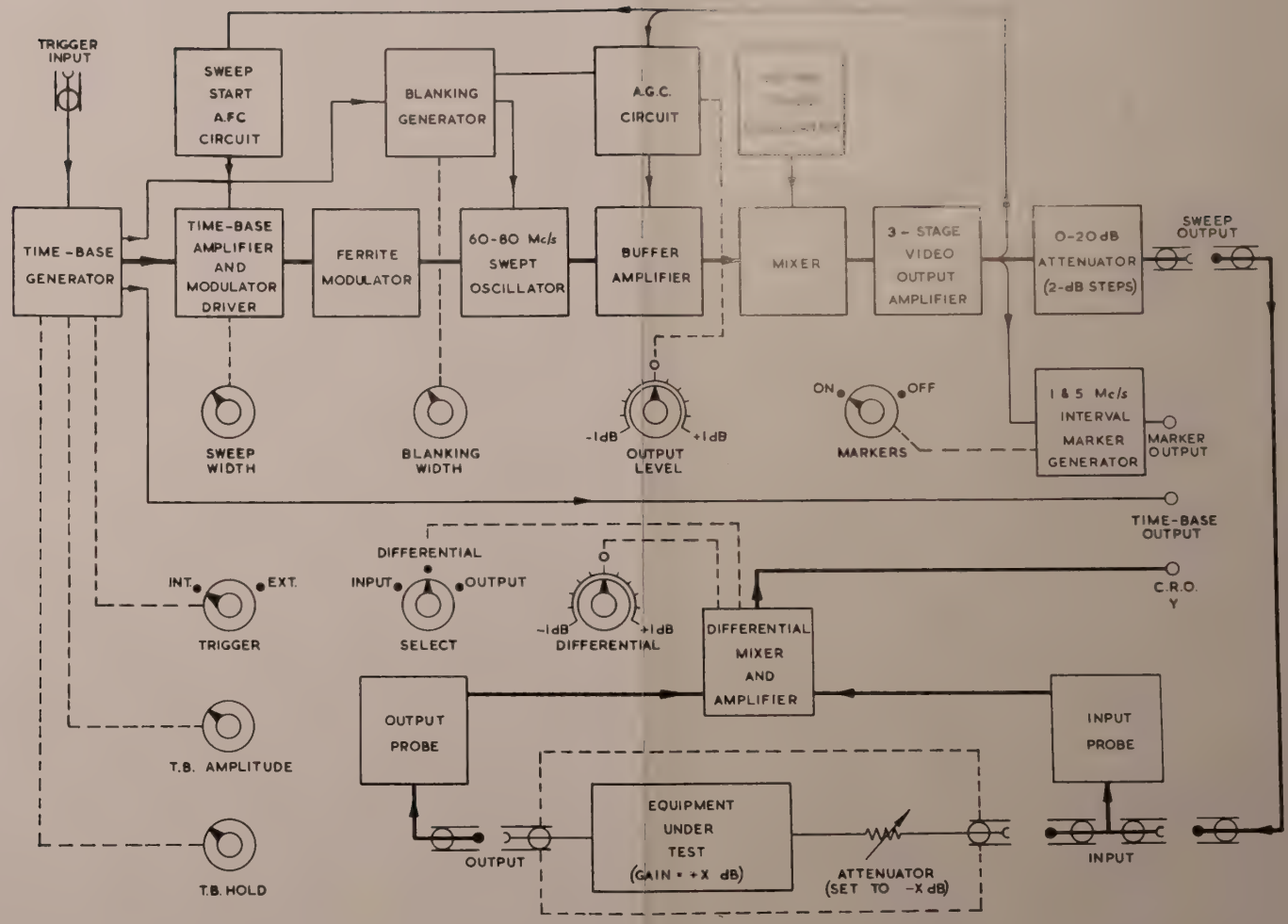
SOS Item No.	Circuit Ref.	Description	Works Ref.
		FUSES AND HOLDERS (continued)	
356	FS3	250-mA Cartridge Fuse.	233-TF1099
357		Holder for FS3.	TB24330/1
		PLUGS, SOCKETS, TERMINALS, AND CONNECTING LEADS	
358	PLA	Plug, Coaxial, type 83 UHF (modified); included in Item 378.	TD26152/6
359	PLB	Plug, Coaxial, type 83 UHF (modified); included in Item 376.	TD26152/6
360	PLC	Plug, 4-pin; included in Item 378.	21-TM5332
361	PLD	Plug, 4-pin; included in Item 376.	21-TM5331
362	PLG	Plug, 3-pin, 5-amp; included in Item 381.	1-TM2560AU
363	PLH	Plug, 4-pin, Mains.	98-TF1099
364	SKTA	Socket, Trigger Input, Coaxial, 75-ohm, type 83 UHF.	58-TF1099
365	SKTB	Socket, Sweep Output, Coaxial, 75-ohm, type 83 UHF.	58-TF1099
366	SKTC	Socket, Single pole.	59-TF1099
367	SKTD	Socket, Coaxial, 75-ohm, type 83 UHF.	58-TF1099
368	SKTE	Socket, Coaxial, 75-ohm, type 83 UHF.	58-TF1099
369	SKTF	Socket, Coaxial, type 83 UHF; included in Item 378.	20-TM5332

SOS Item No.	Circuit Ref.	Description	Works Ref.
		PLUGS, SOCKETS, TERMINALS, and CONNECTING LEADS (continued)	
370	SKTG	Socket, Input Probe, 4-pin.	60-TF1099
371	SKTH	Socket, Output Probe, 4-pin.	60-TF1099
372		Terminal, EARTH.	TB24330/5
373		Terminal, C.R.O. Y.	TB24330/5
374		Terminal, TIME BASE OUTPUT.	TB24330/5
375		Terminal, MARKER OUTPUT.	TB24330/5
376		Output Probe Assembly; includes Items 122, 236, 237, 332, 333, 334, 359, 361, and 377.	TM5331 244-TF1099
377		Cable, 3-core, screened, 6-ft. Included in Item 376.	TB26204
378		Input Probe Assembly; includes Items 234, 235, 329, 330, 331, 358, 360, 369, and 379.	TM5332 244-TF1099
379		Cable, 3-core, screened, 6-ft. Included in Item 378.	TB26204
380		Coaxial Connector Assembly, 6-ft, each end terminated with type 83 UHF plug.	TM4726/18
381		Mains Lead, 6-ft; includes Items 362 and 382. (Not required for TF 1099/1).	TM2560AU
382		Grommet-sleeve; included in Item 381.	4-TM2560AU

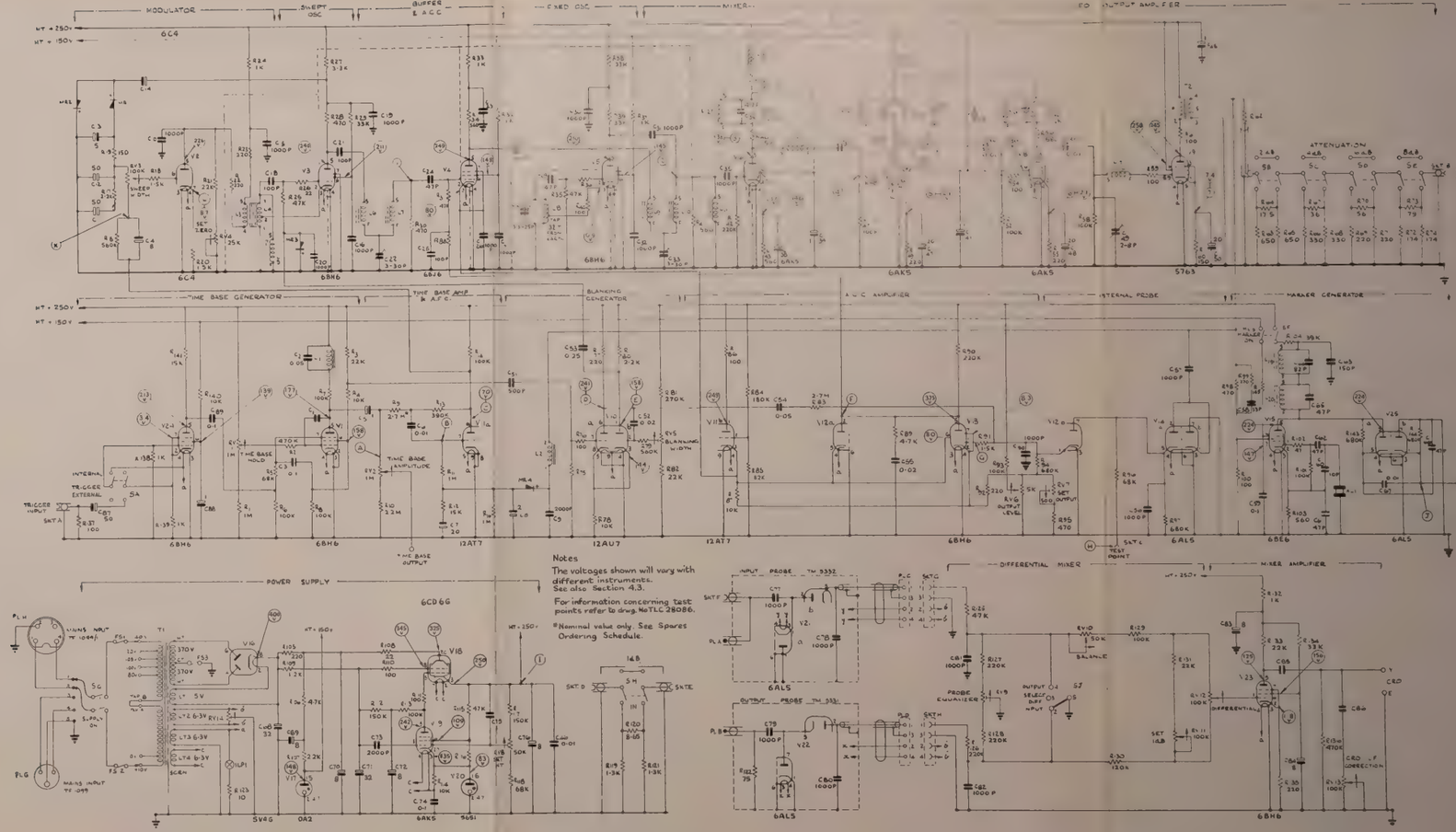
SCS Item No.	Circuit Ref.	Description	Works Ref.
		SWITCHES	
383	SA	Toggle, 2 position, 2 pole.	TB23903/2
384	SB	Toggle, 2 position, 2 pole.	TB23903/2
385	SC	Toggle, 2 position, 2 pole.	TB23903/2
386	SD	Toggle, 2 position, 2 pole.	TB23903/2
387	SE	Toggle, 2 position, 2 pole.	TB23903/2
388	SF	Toggle, 2 position, 2 pole.	TB23903/2
389	SG	Toggle, 2 position, 2 pole.	TB23903/2
390	SH	Toggle, 2 position, 2 pole.	TB23903/2
391	SJ	Rotary, 3 position, 1 pole.	TC4428/441
		KNOBS, AND POTENTIOMETER ACCESSORIES	
392		Knob, Skirted, for OUTPUT LEVEL control.	TB17848/3
393		Knob, Skirted, for SWEEP WIDTH control.	TB17848/3
394		Knob, Skirted, for DIFFERENTIAL control.	TB17848/3
395		Knob, Skirted, for SELECT switch.	TB17848/3
396		Knob, Plain, for TIME BASE AMPLITUDE control.	TB23920/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, AND POTENTIOMETER ACCESSORIES (continued)	
397		Knob, Plain, for C.R.O. L.F. CORRECTION control.	TB23920/1
398		Knob, Plain, for BALANCE control.	TB23920/1
399		Knob, Plain, for SET 1 dB control.	TB23920/1
400		Nyloc Potentiometer Lock Nut for RV4.	TB24000/1
401		Nyloc Potentiometer Lock Nut for RV7.	TB24000/1
402		Nyloc Potentiometer Lock Nut for RV8.	TB24000/1
403		Nyloc Potentiometer Lock Nut for RV14.	TB24000/1
404		Nyloc Potentiometer Lock Nut and Cap for BLANKING WIDTH control.	TB24000/3
405		Nyloc Potentiometer Lock Nut and Cap for TIME BASE HOLD control.	TB24000/3
406		Nyloc Potentiometer Lock Nut and Cap for PROBE EQUALISER control.	TB24000/3
		MISCELLANEOUS	
407		Front Panel for TF1099.	TE26043
408		Front Panel for TF1099/1.	TE26043/1
409		Front Panel Surround and Rubber Fillet. (TF 1099 only).	TE23103/8 TB23984
410		Instrument Case, main section, complete with Side Pockets, but excluding Items 411, 412, 413, 414 and 415. (TF 1099 only).	TE26860

SOS Item No.	Circuit Ref.	Description	Works Ref.
		MISCELLANEOUS (continued)	
411		Extruded section, aluminium; to fit between Items 409 and 410; (TF 1099 only).	TD23713/8
412		Runners, Foot. Set of two; to fit Item 410.	TB26760
413		Foot. Set of four; to fit item 410, (TF 1099 only).	TA11420
414		Pocket Surround, aluminium; set of two. (TF 1099 only).	TB18258/2
415		Cover Plate Assembly; gives access to fuses and mains tapping panel. (TF 1099 only).	TC26147/2
416		Reference Plate for Voltage Adjustment Panel.	TA22394
417		Probe Storage Compartment; includes felt lining and hinge-securing bracket.	TE26046/1 TD26060/1
418		Probe Compartment Cover, including Felt, Captive Screw and Hinge.	TE26046/2
419		Ball Chain; for Probe Cover.	TB22629/1
420		Panel Rails; set of two. (TF 1099/1 only).	TB13370/4
421		Set of two Hexagonal Wrenches, for socket set screws; sizes 2-BA and 4-BA; complete with Linen Bag.	255-TF1099
422		Operating and Maintenance Handbook.	OM1099 /1



BLOCK SCHEMATIC DIAGRAM



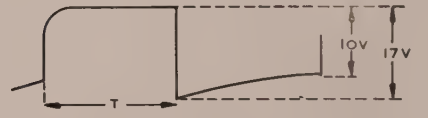
CIRCUIT DIAGRAM

XD 33215

TEST WAVEFORMS

WAVEFORM 'A'

WAVEFORM 'B'

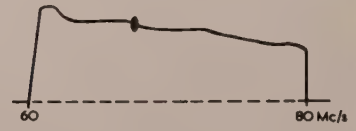


WAVEFORM 'C'

RESPONSE WAVEFORMS

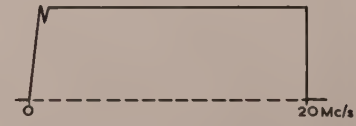
SETTING UP SWEPT OSCILLATOR
RESPONSE AT POINT 1
MARKER PIP SUPERIMPOSED

SEE SECTION 4.7.5.



SETTING UP FIXED OSCILLATOR
RESPONSE AT POINT 4
SHOWING ZERO BEAT

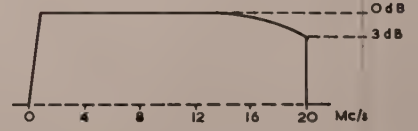
SEE SECTION 4.7.6.



SETTING UP VIDEO AMPLIFIER

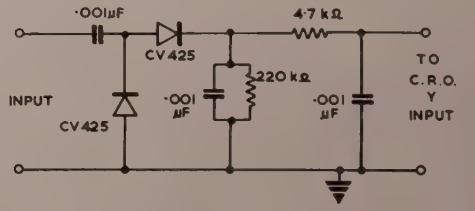
OVERALL RESPONSE

SEE SECTION 4.7.8.



		AMPLITUDE
A	C	270 300V ± 20%
B	C	1V ± 20%
C	C	35V ± 20%
D	B	120V ± 20%
E	B	SEE WAVEFORM
F	A	65V ± 20%
G	A	7·1V ± 20%
H	A	5V ± 10%
I	100c/s HUM	20mV max
J	MARKER PIPS	1V ± 10%
K	C	35V ± 20%
L	C	22V ± 20%
1	A	1·5V ± 20%
2	A	160mV ± 20%
3	A	160mV ± 20%
4	A	170 mV ± 20%
5	A	250mV ± 20%
6	A	2V ± 20%
7	A	5·V ± 20%
8	A	6V ± 10%

FOR MEASUREMENTS ON TEST POINTS
1 TO 8 USE PROBE CIRCUIT SHOWN BELOW



CIRCUIT TEST POINT DATA
AND RESPONSE WAVEFORMS

TLC 28086

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
1·0	1·0	**0**	1·0	1·0
·9886	·9772	**·1**	1·012	1·023
·9772	·9550	**·2**	1·023	1·047
·9661	·9333	**·3**	1·035	1·072
·9550	·9120	**·4**	1·047	1·096
·9441	·8913	**·5**	1·059	1·122
·9333	·8710	**·6**	1·072	1·148
·9226	·8511	**·7**	1·084	1·175
·9120	·8318	**·8**	1·096	1·202
·9016	·8128	**·9**	1·109	1·230
·8913	·7943	**1·0**	1·122	1·259
·8710	·7586	**1·2**	1·148	1·318
·8511	·7244	**1·4**	1·175	1·380
·8318	·6918	**1·6**	1·202	1·445
·8128	·6607	**1·8**	1·230	1·514
·7943	·6310	**2·0**	1·259	1·585
·7762	·6026	**2·2**	1·288	1·660
·7586	·5754	**2·4**	1·318	1·738
·7413	·5495	**2·6**	1·349	1·820
·7244	·5248	**2·8**	1·380	1·905
·7079	·5012	**3·0**	1·413	1·995
·6683	·4467	**3·5**	1·496	2·239
·6310	·3981	**4·0**	1·585	2·512
·5957	·3548	**4·5**	1·679	2·818
·5623	·3162	**5·0**	1·778	3·162
·5309	·2818	**5·5**	1·884	3·548
·5012	·2512	**6**	1·995	3·981
·4467	·1995	**7**	2·239	5·012
·3981	·1585	**8**	2·512	6·310
·3548	·1259	**9**	2·818	7·943
·3162	·1000	**10**	3·162	10·000
·2818	·07943	**11**	3·548	12·59
·2512	·06310	**12**	3·981	15·85
·2239	·05012	**13**	4·467	19·95
·1995	·03981	**14**	5·012	25·12
·1778	·03162	**15**	5·623	31·62

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
·1585	·02512	16	6·310	39·81
·1413	·01995	17	7·079	50·12
·1259	·01585	18	7·943	63·10
·1122	·01259	19	8·913	79·43
·1000	·01000	20	10·000	100·00
·07943	·006310	22	12·59	158·5
·06310	·003981	24	15·85	251·2
·05012	·002512	26	19·95	398·1
·03981	·001585	28	25·12	631·0
·03162	·001000	30	31·62	1,000
·02512	·0006310	32	39·81	1,585
·01995	·0003981	34	50·12	2,512
·01585	·0002512	36	63·10	3,981
·01259	·0001585	38	79·43	6,310
·01000	·0001000	40	100·00	10,000
·007943	·00006310	42	125·9	15,850
·006310	·00003981	44	158·5	25,120
·005012	·00002512	46	199·5	39,810
·003981	·00001585	48	251·2	63,100
·003162	·00001000	50	316·2	100,000
·002512	$6{\cdot}310 \times 10^{-6}$	52	398·1	158,500
·001995	$3{\cdot}981 \times 10^{-6}$	54	501·2	251,200
·001585	$2{\cdot}512 \times 10^{-6}$	56	631·0	398,100
·001259	$1{\cdot}585 \times 10^{-6}$	58	794·3	631,000
·001000	10^{-6}	60	1,000	10^{6}
·0005623	$3{\cdot}162 \times 10^{-7}$	65	1,778	$3{\cdot}162 \times 10^{6}$
·0003162	10^{-7}	70	3,162	10^{7}
·0001778	$3{\cdot}162 \times 10^{-8}$	75	5,623	$3{\cdot}162 \times 10^{7}$
·0001000	10^{-8}	80	10,000	10^{8}
·00005623	$3{\cdot}162 \times 10^{-9}$	85	17,780	$3{\cdot}162 \times 10^{8}$
·00003162	10^{-9}	90	31,620	10^{9}
·00001000	10^{-10}	100	100,000	10^{10}
$3{\cdot}162 \times 10^{-6}$	10^{-11}	110	316,200	10^{11}
10^{-6}	10^{-12}	120	10^{6}	10^{12}
$3{\cdot}162 \times 10^{-7}$	10^{-13}	130	$3{\cdot}162 \times 10^{6}$	10^{13}
10^{-7}	10^{-14}	140	10^{7}	10^{14}

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